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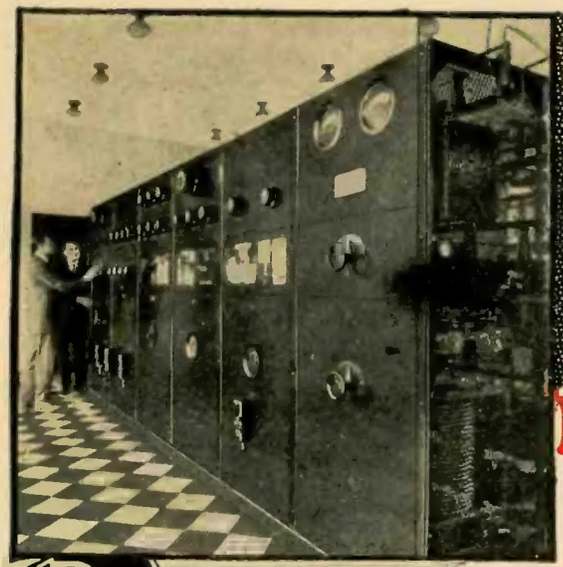

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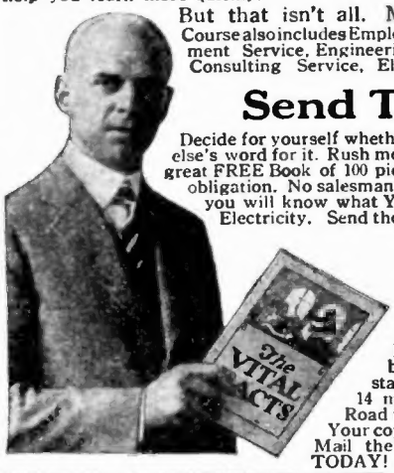


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Whole No. 154

# Science and Invention

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## IN OUR NEXT ISSUE

### *Do You Know How Buried Treasures Are Located?*

A complete resumé will be given of various types of latest scientific devices designed for the purpose of detecting underground gold, silver, water, oil and metallic treasures.

### *The Moon Has an Atmosphere!*

A series of intensive researches have been made and Prof. Donald H. Menzel, the well-known scientist, has announced that, contrary to general opinion, the moon has an atmosphere.

### *How Will Large Cities Appear 100 Years Hence?*

Reproductions of futuristic paintings will show artists' conceptions of the appearance of New York and other large cities in the not so far distant future.

### *Would You Go Behind the Scenes at Hollywood?*

Even though you may not have this opportunity, you can learn about what takes place on movie locations at Hollywood from an authentic article.

### *How Are Wild Animals Trained?*

There are various methods used by different trainers and they will be thoroughly described and illustrated.

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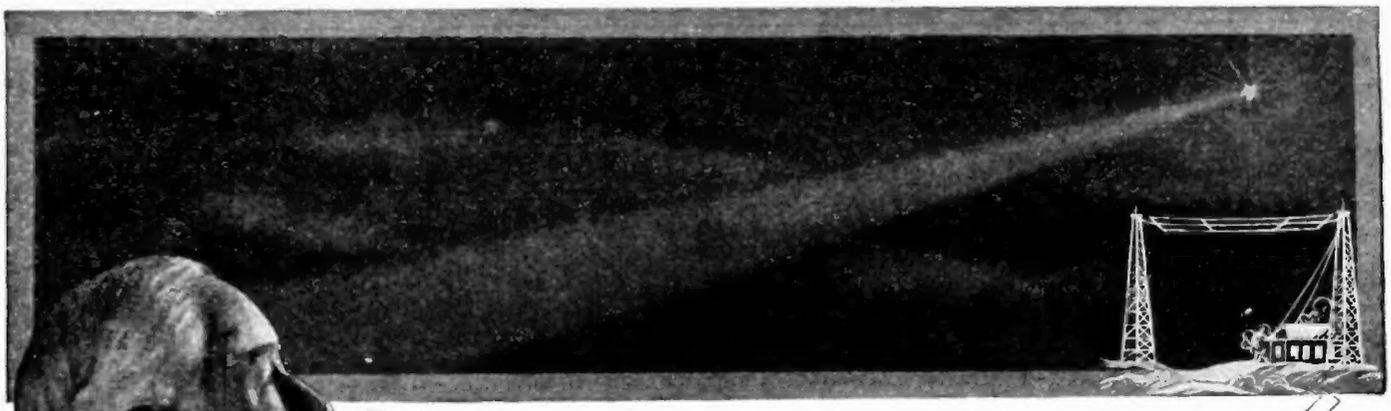

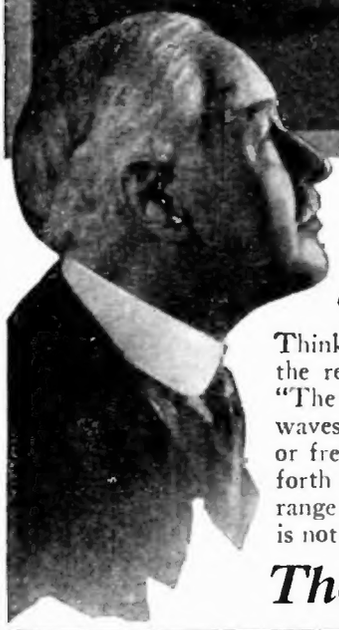

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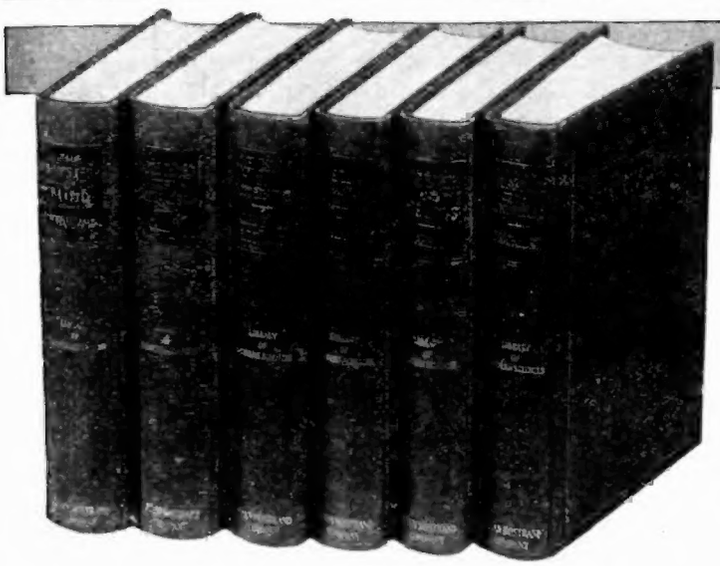

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# DON'T TAKE CHANCES WITH YOUR INVENTIONS

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THIS is the story of my own invention which is bringing its manufacturer a fortune every month—and is bringing me nothing but regrets.

About two years ago I had an idea for a useful household article. Though it was only an idea it was a good one and the more I thought about it, the more anxious I became to perfect it and get it patented.

I worked steadily over my idea for six months—improving it a little each night, until I got it to a point where it seemed to be perfect.

Then I took my plans to a mechanic. I figured that the cost of the model would be well within my slender means because, as far as I could tell, there was only a couple of days' work on it.

The month that followed brought me every torture known to an inventor! My money melted away like ice in a July sun. Every day some new and unforeseen trouble kept the model from working—and every day I became $15 poorer!

Discouragement and anxiety were followed by debt, and before I knew it I was out several hundred dollars with nothing to show for it but a number of worthless models and an irritable disposition. Everything connected with my invention made me sick and the future looked quite hopeless. Just as I was about to give the whole thing up in despair, my mechanic notified me that he had at last made a model which worked perfectly!

This good news gave me new courage and I soon recovered my old enthusiasm.

I took my plans and my model to a patent attorney who made a search for me and advised me that I could get good broad claims. I filed my application immediately and a week later received the receipt which showed that my invention was safely in Washington.

The next month was as rosy as the preceding one had been gloomy. I fairly "walked on air" because I knew my patent was safe, my claims were good and my model worked perfectly. There was nothing more to worry about, I thought.

One day, while I was in the midst of an imaginary conference involving thousands of dollars, a letter came from my Patent Attorney which threw my entire future into the scrap heap and sent cold chills down my spine! Here is the letter:—

"I regret to inform you that interference has been declared on your invention."

"Kindly see me at your earliest convenience."

Upon arriving at my attorney's office I was told that someone had filed an application for the same invention about the same time that I had. The future of my invention rested on whether or not I could prove "prior conception."

My patent attorney investigated the matter and informed me that the other inventor —a man in Kansas—had kept a legal record of every step he took in his invention, and could prove that he thought of the idea first.

There was no use going to court. I had kept no records and could prove nothing. My brother had seen me working on the plans, but he had signed nothing—and besides he was in China.

There was nothing left for me to do but start paying off my debts.

If I had only known enough to keep an accurate legal record of my idea I would have insured myself an enormous income for life—instead of running blindly into heavy debt!

This costly mistake taught me the most valuable lesson I ever learned. It showed me that there are a great many things an inventor does not know,—little things to be sure,—but mighty important ones! I made up my mind to master them and was fortunate enough to find a course "made to order" for me—the course given by the Bureau of Inventive Science.

Perhaps you know, better than I did, the importance of keeping a legal record of your inventions. But there are other things of equal importance which you may not know—and which may be as costly to you as ignorance of the method of keeping a legal record was to me.

This course, prepared by Raymond Francis Yates and 14 associates, dwells at length on such important subjects as keeping legal records before filing an application; the various things every inventor should know about manufacturing methods and promoting; the best way to apply for a patent and the various kinds of patents that can be had; the laws of the Patent Office and the exploitation of patent rights. It explains clearly and simply what every inventor should know about organizing a company and marketing an invention. It dwells thoroughly upon things like cost of production, quantity production, fixing the price of the article, salesmanship, and countless other important items which nearly every inventor must know in order to be successful.

## Know These Facts!

Do you know how to go about manufacturing your invention? Do you know how to figure cost of production and are you thoroughly acquainted with the various methods of quantity production? Are you sure that your invention can be sold at a profit?

Are you familiar with castings, milling machine work, drill press and die stamping? Do you know what parts of your invention should be cast or milled or die stamped or are you willing to leave it to the mechanic who may take advantage of you at the rate of $1.50 per hour?

Are you sure you know what NOT to invent? Can you determine what inventions are practical and what are useless?

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Thousands of Ultradyne owners have asked us to solve this very problem. It deals with an easier, more economical method of operation and maintenance of your present Ultradyne Receiver.

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R. E. Lacault

*Chief Engineer,*
PHENIX RADIO CORPORATION.

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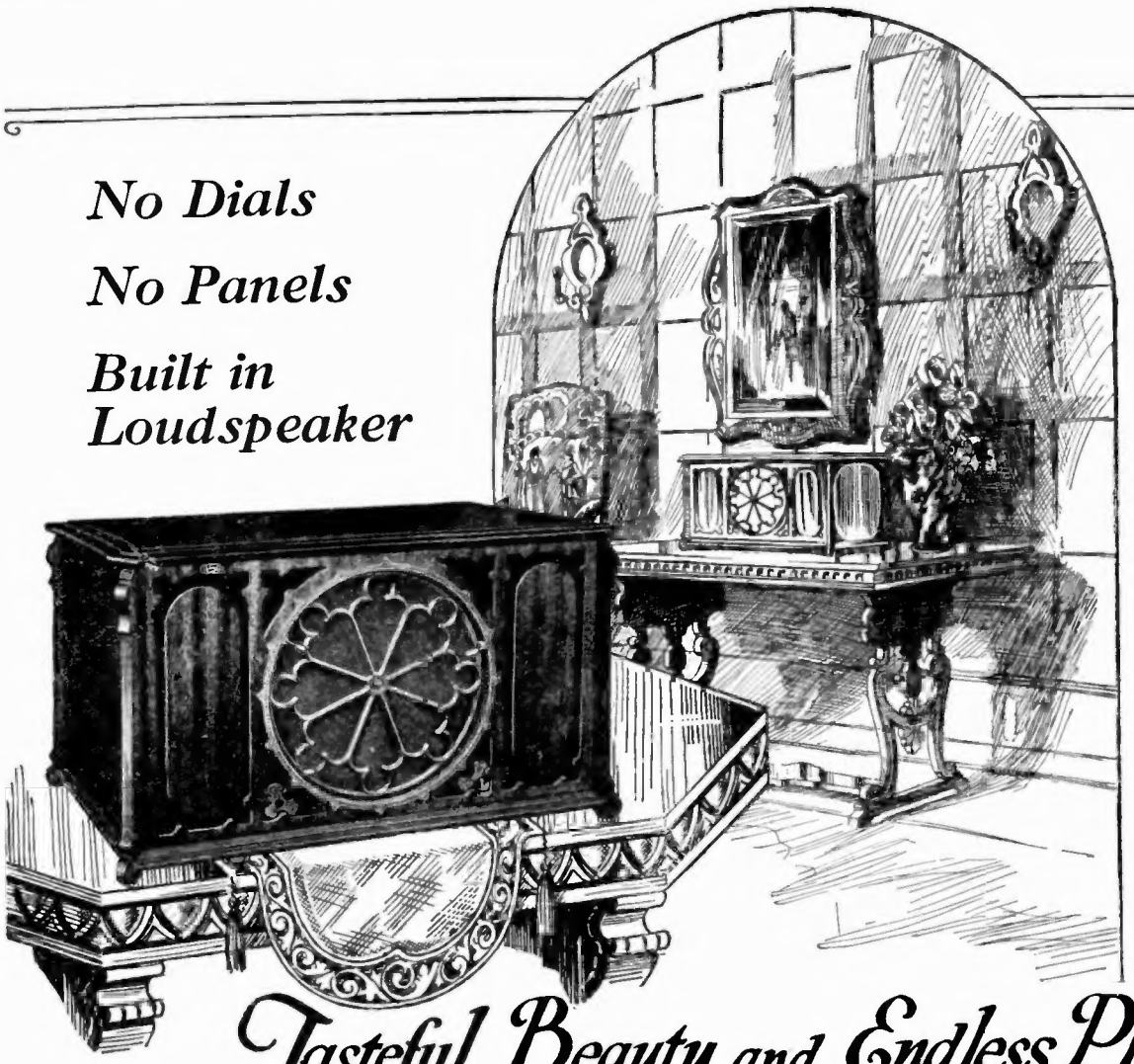

# *Tasteful Beauty and Endless Pleasure*

THIS utterly new kind of receiver, the ULTRADYNE, Model L-3, achieves the truly artistic form and simplicity of line. It blends harmoniously into almost any scheme of furnishings. Unobtrusively in good taste.

New, too, in its extremely simple operation. Stations are selected by two inconspicuous levers. No intricate tuning.

This new beauty, this new simplicity, is amplified by an accentuated tonal richness, range of selection and freedom from extraneous sounds. It is radio's utmost achievement further refined and extended.

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*Ultradyne Model L-3 is a 6 tube receiver employing the principles of the best circuits, greatly refined and marvelously simplified. In a Duco-finished, two-toned mahogany cabinet.*

**$135.00**

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The Ultradyne was designed by Mr. R. E. Lacault, E. E., Chief Engineer of this Company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories. To protect the public Mr. Lacault's personal monogram seal (R. E. L., shown here) is placed on the assembly lock bolts of all genuine Ultradyne Model L-3 Receivers. All receivers are guaranteed so long as these seals remain unbroken.

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## MODEL L-3

PHENIX RADIO CORPORATION, 114G East 25th St., NEW YORK

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## I Will Put You Into Electricity—Right!

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Twenty-two (22) Noted Engineers helped me make this training complete and up-to-date; men from General Electric, Westinghouse Electric, Western Electric, Underwriters Laboratories, Massachusetts Institute of Technology—from the greatest Electrical corporations and leading universities. These men would not lend their names and support to any ordinary school or course. They have helped me develop a new method of instruction, simpler, easier to understand than ever existed before.

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So I say—go into Electricity! My training must prepare you for a good Electrical job and a raise in pay, or **I will refund every cent of your money.**

I send you 4 costly Electrical Outfits

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*Dunlap Job-Method* goes way beyond old-fashioned "book learning." *Your object in training is to prepare for a fine Electrical job, for bigger pay.* And so we train you on standard Electrical equipment, with standard Electrical tools. You learn by doing actual Electrical jobs—and you learn quickly, with less effort, because these jobs are *interesting.* I supply all this equipment without one penny of extra charge.

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We maintain a large Employment Service for the benefit of our students, graduates, and Electrical employers all over America—under the direction of H. A. BURGKART, Employment Expert. No charge for this service. We realize that thousands of our students enroll to secure better jobs and bigger pay, and we help them accomplish this by providing the right kind of training, and a real, efficient employment service.

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There has been sensational improvement in home-training in Electricity. We offer features, service and benefits that were called "impossible" in the past. Let me prove to you that my training absolutely leads to a fine Electrical job and a big raise in pay. Let me show you the opportunities waiting for you in Electricity.

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1. Bell-Wiring, Burglar-alarm, soldering and taping equipment, standard size and quality.
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3. $10 Motor, same type as the big fellows in a power plant.
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Volume XIII
Whole No. 154

Science and Invention

February, 1926
No. 10

Editorial and General Offices, - - - 53 Park Place, New York

*"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY*

# MODEL BUILDING

**By HUGO GERNSBACK**

WE Americans pride ourselves on being citizens of the greatest mechanical nation on earth. We point with pride to the fact that we have more railroads, more telephones, more telegraphs, more elevators, more electrical plants, and more factories than any other nation in the world. In a mechanical world we are the most mechanical. We educate our 4-year-old boys with model trains, model building blocks, model constructional toys, and many others, but when it comes to actually building models ourselves we must take a back seat. Such countries as England and Germany are far, far ahead when it comes to model building.

In England, for instance, the art of model building is at its highest cultural state. There is not an Englishman living who does not know something about the intricacies of some model building, whether it be building a locomotive, an electrical motor, an automobile, a model lathe, or whatnot. In England there are magazines and periodicals devoted exclusively to model building, where the builder is shown what his contemporaries are doing. Prizes are given for model building and the art, for so we may call it, is encouraged from all sides. Any visitor who has gone to England or Germany and has seen the activity in model building has invariably been astounded at the magnificent work that is being done in these countries. We see, for instance, locomotives, exact duplicates of their big brethren; these models measure anywhere from 1 to 3 feet long, and some are even smaller, others larger. They not only look the part but actually work, and work well.

Model making, as it is understood, is not just duplicating the outside appearance of the particular machinery, but seeing to it that it actually works the same as the original. The same material used in a huge locomotive, if such is the subject, whether it be brass or steel, is, of course, used in the model, which furthermore is also operated by steam.

The art of model making should not be confused with commercial ready-made models. The real model builder will look askance at any such suggestion, because the whole fun and instruction lies right in the building of the model itself. To build such a model one must of course be a first-class mechanic, must know how to handle the lathe, must know where to have small castings made, must know how to polish, drill and cut all sorts of materials, and must have the patience to carry out the work to completion.

The future engineer or business man derives an undreamt of education from building such small models and for that reason it should be understood that the models are not constructed wholly with an eye to entertaining the builder, but it gives him a wonderful insight into the intricacies of the machine that he is duplicating on a small scale. Not only that, he also learns how to handle materials As a matter of fact, the building of even a single model is a far-reaching education in itself.

While there is, of course, some model building going on in America, there is mighty little of it, and while there are companies who make a specialty of selling materials for model building, they themselves will admit that the materials are usually employed by inventors who are getting up models of new industrial machines or devices which they hope to patent and sell. This, of course, is not model building, as the term is to be understood, because the minute model building assumes a commercial aspect, it automatically becomes cold business and is no longer an art.

In England and Germany there are a great many clubs and associations where ideas are exchanged, advice given, show-rooms where models can be exhibited and regular expositions held. There are even prize competitions for the best models built, and there are firms who willingly buy handsome models for display in windows to attract the customers to the establishment's wares. The largest show window crowds I have ever seen were attracted by good models.

Why model building should not flourish in this country has always been a great mystery to me. In this country, where the mechanical and electrical arts are on a very high level, and where experienced people are wanted at all times, it is a pity that the model building art is practically non-existent. Would it not be an excellent idea for the few model builders in this country to form clubs in their localities where models can be shown and ideas exchanged?

SCIENCE & INVENTION, for one, will be glad to feature this movement at any time by giving fullest support and publicity to any such movement. SCIENCE & INVENTION will be only too glad to print the names of such clubs or meeting places, and with this in view, in the March issue we are starting a **Model Builders' Department,** where photographs of models, as well as full descriptions and details will be published for the benefit of all. Send us photos and descriptions without delay. And remember that the very essence of model making is perfection of workmanship. A good reproduction of a locomotive should have no defect. If you can make a good model you are a skilled mechanic.

Hats off to the genius of American model enthusiasts. Let's go!

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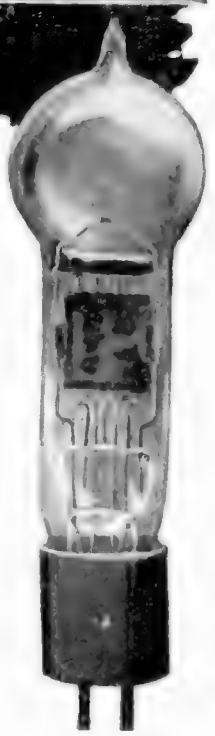
# Photo-Electric Cell Locates Fires

By J. KAY LONDON

PHOTO ELECTRONS LIBERATED BY ACTION OF LIGHT ON SENSITIVE COATING
RECEIVING REFLECTOR
PROJECTOR
SPECIAL LIGHT SENSITIVE TUBE
SENSITIVE COATING
GRID
PLATE
FILAMENT
RELAY
ALARM
BALLAST TUBE
10 TO 15 MEGOHMS
6 VOLT "A" BATTERY
"C" BAT. 30 TO 45 VOLTS
"B" BAT. 90 TO 150 VOLTS
Here is the circuit of a new light-sensitive electric cell which amplifies. When the light intensity changes, the current changes.
(C) 1925 BY SCIENCE & INVENTION



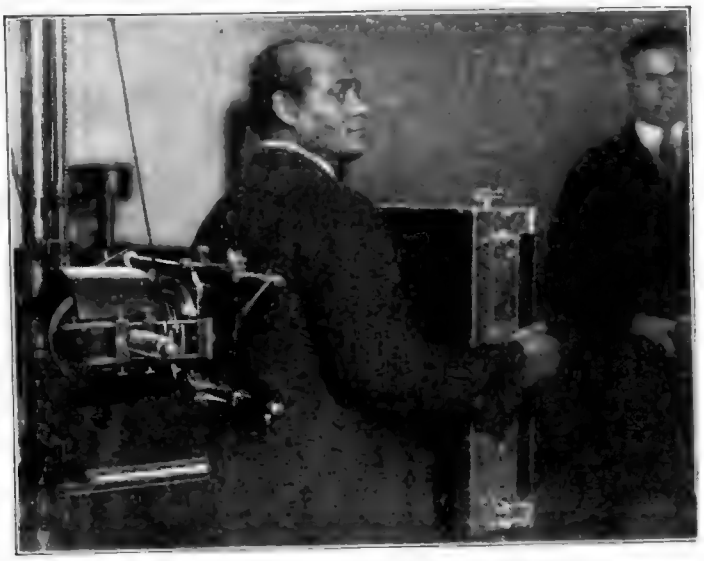
At the right is a photograph of this new light-sensitive cell and at the left and above are shown suggestions for a novel and unusual use for such cells. Strung between two points in mountainous regions are cables and on these cables a small car operates, carying a powerful searchlight. The car automatically travels from one end to the other of the cable, reversing its travel at each end. It is directly focused on a lookout station of the type shown above and the photo-electric cell passes an even flow of current. If, however, the light beam is dimmed by passing through smoke, an alarm is sounded at the lookout station.

*Photo courtesy Westinghouse Electric and Mfg. Co.*

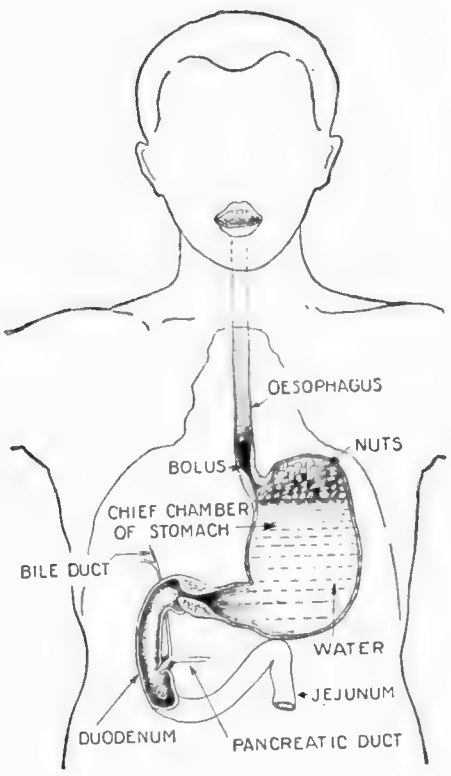
# Most Wonderful Stomach

## A Diet of Nuts, Watches and Kerosene

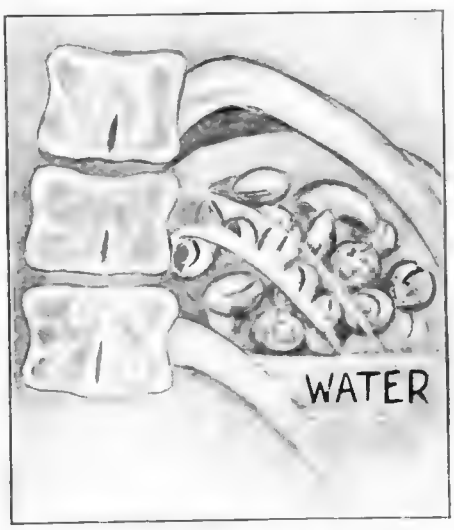
The photograph above shows Hadji Ali spraying kerosene on a burning stick. He had just finished drinking a gallon of water and a pint of kerosene. His stomach is under absolute control and Hadji first regurgitates the kerosene, which is set on fire, as the photo shows, and then extinguishes the flames with the gallon of water still in his system. Joseph H. Kraus, Field Editor of this publication, is shown immediately in back and to the left of Hadji.

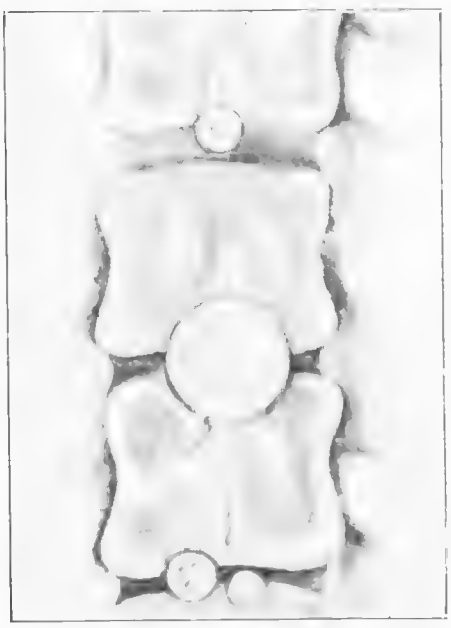


In the photo above Mr. Ali is standing in front of a film holder, while the X-rays are penetrating the flesh and tissues and producing the shadows of nuts or the watch on the film. Mr. Ali gave this demonstration to a staff of physicians and newspaper men, and demonstrated how he could swallow three live gold fish and bring them back alive; how he could swallow three differently colored kerchiefs and bring forth any color called for. The X-rays proved there was no trickery.

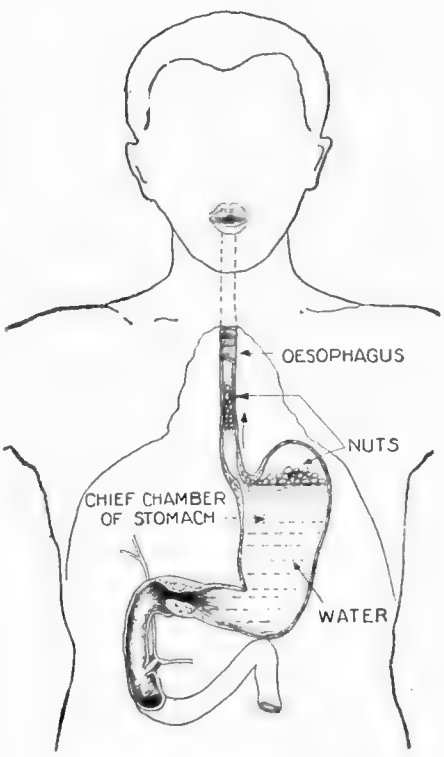



The diagram above illustrates how Hadji Ali is able to swallow three dozen hazel nuts and one almond. When he is examined fluoroscopically—that is, by means of X-rays and a fluoroscopic screen—the nuts can be seen floating on the surface of the water in his stomach. He is able to separate the hazel nut from the almond at will. It will be noted that if the stomach is contracted, the nuts are pushed up into the oesophagus. This contracted condition of the stomach is illustrated in the diagram at the right-hand side of this page.



The top photo is an X-ray view of the nuts floating on the surface of water. The bottom shows the position of a watch in Hadji's stomach.




Hadji Ali's demontsration, held before a group of scientists and physicians, was given through the courtesy of Captain Frank G. Kerk. The two X-ray views were taken by the K and B Electric Equipment Company, Inc., of New York, through the courtesy of Kny-Scheerer. In the X-ray photograph at the left a watch may be seen. This Mr. Ali had no difficulty in swallowing. Unfortunately, the position of the watch directly in front of the spinal column did not produce an exceptionally good photograph, because it had to be developed very weakly.

The map above shows the proposed route to be taken by Arctic explorers who will employ boats, specially designed motor sleds and airplanes to complete a lengthy trip, during which they expect to pass directly over the North Pole. The sleds to be used are described below.

# Motor Sleds to Explore North Pole

By J. KAY LONDON

A FRENCH expedition is planning to attempt to reach the North Pole next summer, and in order to accomplish their purpose, six specially designed auto-sledges are under construction. These vehicles will travel equally well on the surface of water or on ice and can change from one element to the other with hardly a pause. Our illustration at the bottom of this page shows the probable appearance of sleds of this nature equipped with caterpillar treads for traveling on ice and bouyant enough for water travel. The route that the party will follow is shown in the map at the top of this page.

Naval Lieutenant Sales will head this expedition and the party will be composed of many well-known French scientists. Several of the larger scientific societies of France are financing the expedition, the cost of which is estimated at three billion francs.

The party will be guided by Captain Otto Sverdrup, a Norwegian explorer who has won fame on several occasions by means of his intrepid journeys into the lands of perpetual ice. Captain Sverdrup is also the inventor of the amphibious ice sleds which it is said will travel over very rough ice at a speed of 12 to 16 miles an hour and will enter the waterway or climb from it to ice under their own power.

The novel part of this expedition is that the sleds, weighing 10 tons each, will be so equipped that they can carry dismantled seaplanes. With the latter it is proposed to fly from the North Pole to Cape Barrow, after establishing a home camp at or near the pole. Two planes will be carried and the four remaining sea sleds will be employed for exploration purposes over the unknown region between Alaska and the North Pole. These sleds will eventually follow the airplanes to Cape Barrow.

In the expedition there will be a total of 16 men. Ten of them will be specially trained in the handling of the new sledges while six of them will be expert airplane pilots. They will probabiy leave France about the end of April and will sail for King's Bay. From here, the sleds are to be started and calculations show that the pole will be reached in from 10 to 15 days, barring unforeseen accidents. When the party reaches King's Bay they will of course wait for ideal weather conditions which will be reported to them via radio. By means of this communication system, they can keep informed of the weather throughout the world and from this, suitable conclusions can be drawn. The start will then be made, proceeding direct to the pole as shown on our map.

Exploration will be carried on with the assistance of the amphibious ice sledges, all being radio equipped.

Here we show a view of the proposed motor sleds which will carry men, provisions and knock-down airplanes. The fuselage of one of the planes can be seen on the sled above.

The illustration at the right shows the departure of two large seaplanes from a point at or near the North Pole. Note that radio equipment is carried and that the sleds are provided with suitable antennas. If the proper apparatus is taken with the expedition, the novel sleds need never be out of touch with each other or with their home camp. It is hoped that by using constant radio communication, disasters such as have befallen other Arctic explorers will be avoided, and that the trip will meet with perfect success. This hope can only be realized if every emergency is foreseen and provided for and at the present moment of writing, it seems as though just this has been done

After the planes leave the amphibious sleds at their base, they will proceed southward toward Cape Barrow, Alaska, and landing there they will again take off and start for New York, the trip being made in comparatively short "hops." At New York the planes will be again dismantled, placed on a trans-Atlantic ship and sent to France. Here they will again be assembled and the expedition will finish its trip by flying directly to Paris.

One of the six sleds that will be used is lighter in weight than the others, and is so designed and constructed that it can be operated at high speeds. This will be used mainly as a relief sled and for emergency purposes.

If all of the work progresses as smoothly as the plans seem to provide for, the sled party will spend at least six weeks of exploration at and around the pole, and will fully investigate the great unexplored ice districts surrounding that point. It is hoped that these explorations will reveal much interesting data relative to land, water and ice conditions around the pole and will clear up much misunderstanding relative to this territory. After the explorations have been completed to the satisfaction of the party leaders, the sleds will proceed to cross the ice in the direction of Cape Barrow and will arrive there several months after the airplanes. The party will be entirely prepared and equipped to spend the winter in the ice if it should so happen that such a course becomes necessary.

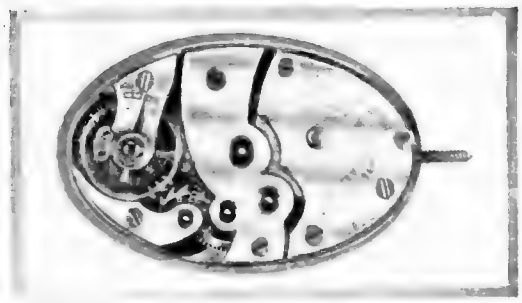
It may seem from this resumé of the essential facts that the plans are overly ambitious but much of the preparatory work has already been carried through and the one important point to be decided is the practicability of the motor sleds. They will be thoroughly and carefully tested several times before the expediton starts and it is said that many secret points used in their construction will enable them to perform seeming marvels. They will be propelled by gasoline engines.

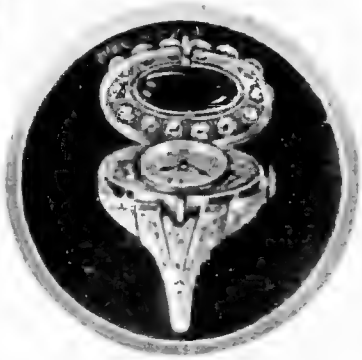
Here we see the polar explorers ensconced in their exploration headquarters at or near the North Pole. The motor sleds equipped with radio are seen at the right of the illustration and the seaplanes are just starting off in their dash for Cape Barrow, Alaska.

# A Watch On Your Ring

By SAMUEL BERNARD

Left: One of the smallest watches in the world is set into a finger ring and equipped with a cover in the center of which is set a precious stone surrounded by a series of small diamonds. This unique combination, with the cover unlatched and partly open, is shown in the photograph directly below. These ring watches are made in America now, as well as abroad.

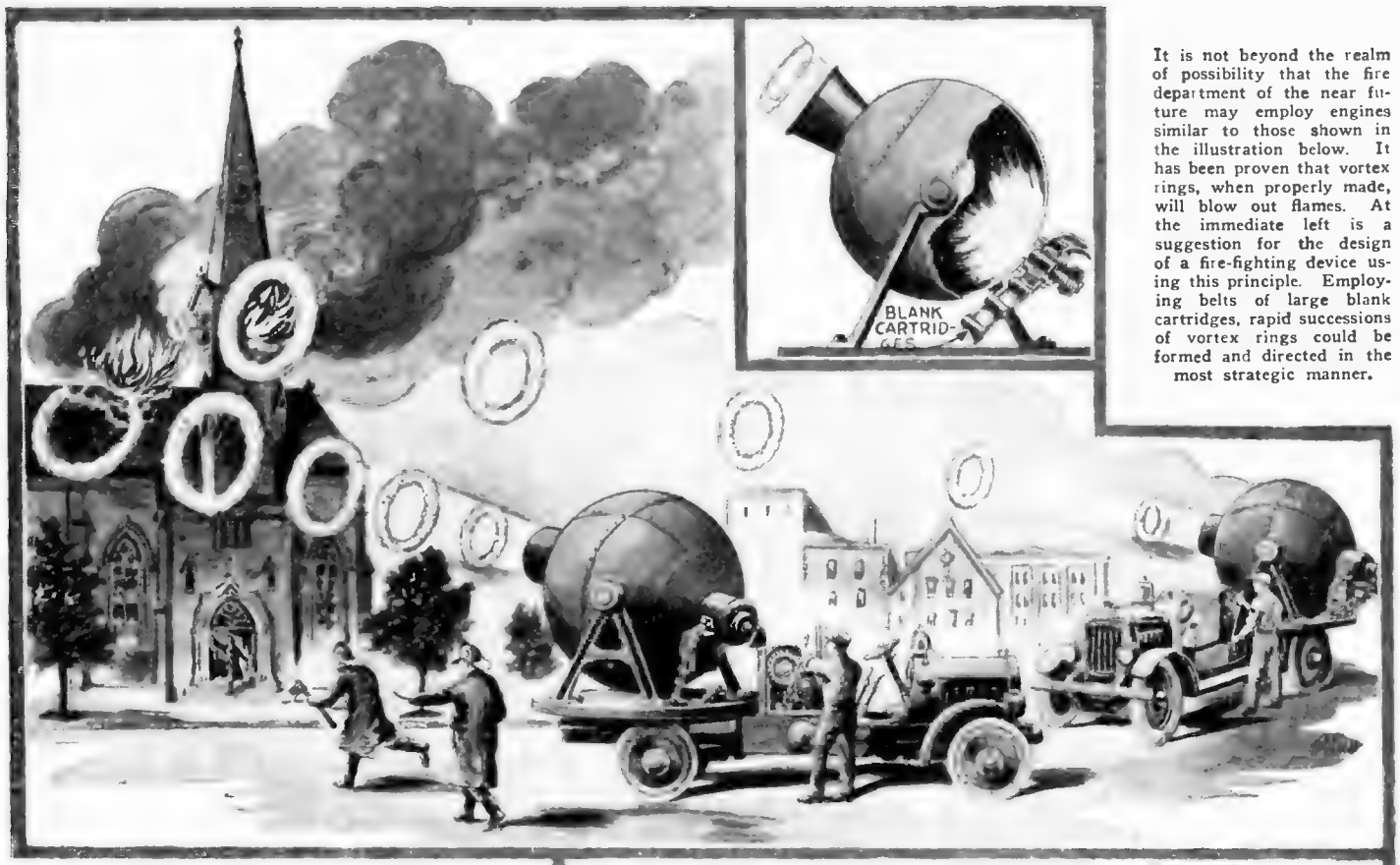




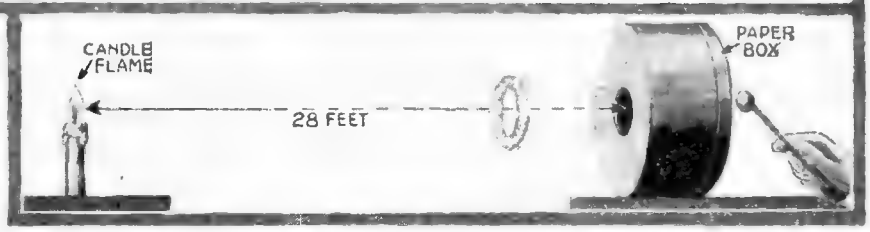
Above: A greatly enlarged view of the operating mechanism of this watch, made for the last Empress of Brazil. Three years were consumed in making this watch. It cost $25,000.

The illustrations below show the comparative sizes of some of the parts of this smallest watch, the complete movement and the size of the casing. At the extreme right is a standard size watch shown for comparison. The entire movement of this timepiece is only about the size of a dime in outside diameter and to the left of the illustration of the complete movement are shown some of the gears and the two springs.

# Vortex Rings to Extinguish Fire




It is not beyond the realm of possibility that the fire department of the near future may employ engines similar to those shown in the illustration below. It has been proven that vortex rings, when properly made, will blow out flames. At the immediate left is a suggestion for the design of a fire-fighting device using this principle. Employing belts of large blank cartridges, rapid successions of vortex rings could be formed and directed in the most strategic manner.




Experiments made in the offices of SCIENCE AND INVENTION Magazine proved that with a very small vortex ring generator employed as at the right, a candle flame could be immediately extinguished at a distance of 28 feet from the source of the rings. This should suggest a series of interesting experiments to those who are inclined in that direction. Use a comparatively large hole, fill the box with smoke so that the rings can be seen and then tap the end opposite the the hole. The result is shown.—J. Kay London.

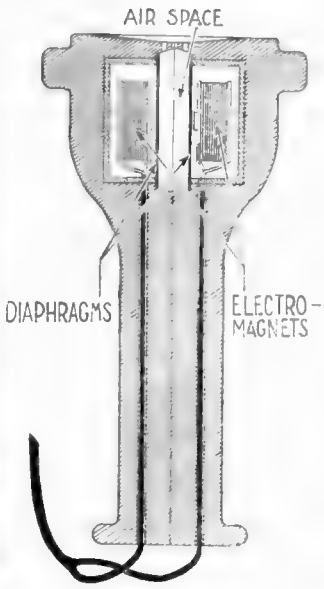
# Novel Phone Receiver

EVER since the invention of the telephone and the beginning of its wide use in business and social life, it has been found to have many disadvantages in its usual form. Since then, hundreds of accessories for attachment to standard telephones and also improvements of these instruments have been invented. Cushions and other noise excluders have been devised, but have not been particularly successful. It seems that the extraneous noises around a telephone user are about the most annoying that can be imagined and in order to eliminate this effect, one clever inventor has designed the separable receiver illustrated at the left. This instrument consists of two complete receivers connected together in the same circuit. When the parts are assembled, the unit can be employed for listening with one ear, but by separating the two parts, the two sound reproducing elements can be applied so that the user can listen with both ears. In this way, audibility is increased greatly and, furthermore, one ear is not open to external sounds, as is the case when an ordinary receiver is employed. The mechanical design of this instrument is quite clever, and the two parts are held together by means of a unique mortise joint. The connecting cords are so designed that when the receiver is used as a single unit, they are not in the way, but the two halves can be separated an ample distance for application to both ears.

*Courtesy Audak Co.*

A newly designed telephone receiver is shown in the photographs and drawing in these columns. In appearance it somewhat resembles a standard type, but in operation it has advantages over others.

This new telephone receiver is shown above in use in the standard manner, while at the right it has been separated into its two component parts, and is being used for listening with both ears. Thus extraneous noises are excluded.



# Non-Rolling Ship

Photos show appearance of ship equipped with the long corrugations that prevent rolling even in heavy seas.

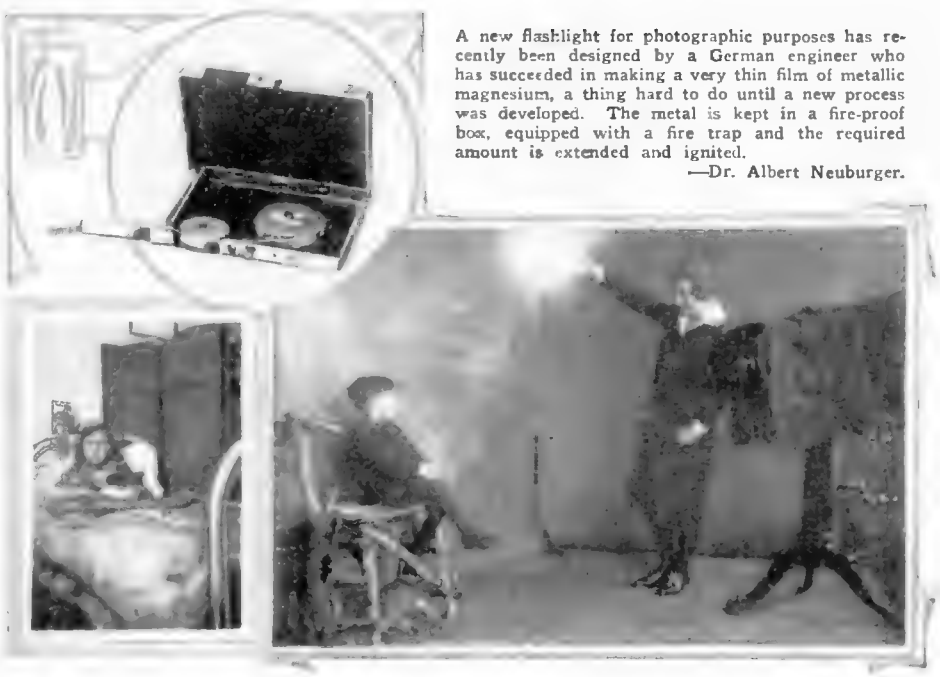
Above: A lightly loaded ship equipped with the new bulges for the prevention of rolling and for increasing overall efficiency.

The photograph immediately above gives an excellent idea of the size and placement of the anti-rolling bulges.

RECENT tests made on three British steamships of 7,400 tons dead weight have shown that a newly designed system will quite effectively prevent the rolling of a vessel even though high seas are encountered. This system takes the form of two long corrugations placed on each side of the vessel and extending from stem to stern. These ridges are reinforced by interior girders and merge into the lines of the boat at both the bow and the stern. They are placed so that when the vessel is fully loaded the top one will be just below the water line and the other one 4 to 6 feet further down or just above the bilge line. The merging of the ridges reduces the resistance to the water and at the stern reduce the eddy effect. It is also said that they deliver a more solid and stable mass of water to the propellers, decreasing the amount of power necessary to drive the vessel ahead. The corrugations add about 6 per cent. to the width of the ship. The great point to consider in connection with these bulges is that they prevent the ship from rolling and thus alleviate one of the biggest woes of ocean travel—seasickness. Undoubtedly in the future, those ships that are equipped with this anti-rolling system will enjoy a much greater popularity among those addicted to the malady of seasickness. We may even expect to see, in the near future, competition between steamship lines aided by "anti-sea-sick" propaganda.

H. H. DUNN.

# Photographic Flashlight



A new flashlight for photographic purposes has recently been designed by a German engineer who has succeeded in making a very thin film of metallic magnesium, a thing hard to do until a new process was developed. The metal is kept in a fire-proof box, equipped with a fire trap and the required amount is extended and ignited.

—Dr. Albert Neuburger.

# The Light-Beam Piano

*Light and Sound Are Made to Play Strange Tricks and Salt Crystals Reproduce From Phonograph Records.*

**By A. P. PECK**

**The illustration at the right and on the cover of this issue shows our artist's conception of what the "light-beam piano" may look like when it has been reduced to a practical commercial form. In the type shown, several selenium cells are employed, although it may be that this number will be reduced. There are also several loud speakers used in connection with this piano so that high, low and medium notes can be reproduced with the greatest fidelity. A vacuum tube amplifier makes great volume possible.**

IT WAS with no little eagerness and anticipation that we scanned the flying scenery of Long Island from our comfortable seat in the smoker and looked forward to our arrival at Mill Neck, the nearest railroad station to the Batterman estate, where H. Grindell Matthews, the inventor of the so-called "death ray," has been conducting numerous experiments with unusual and most interesting instruments. Arriving at our destination, a car whirled us through the countryside and in a very few moments we were shaking hands with H. Grindell Matthews himself and his right-hand assistant, Bernard J. Lynes. After a little casual conversation, we all walked across the lawn to a small low building, behind the closed doors of which Mr. Matthews and Mr. Lynes have been constantly at work for some time past. Entering, we found ourselves in the presence of one of the finest and neatest arrays of instruments that it has ever been our privilege to examine. Most prominent among the unusual and queer-looking display was a table upon which was mounted what we later came to know as a *Luminaphone*. This device is so made and its parts are so arranged that by means of a controlled beam, or rather, beams of light, tones comparing most favorably with the finest of pipe organs can be produced. The apparatus necessary for doing this even on a large scale will take up very much less room than a standard pipe organ and, furthermore, has several advantages over that instrument. It is not affected by various atmospheric conditions and once tuned is always tuned. Dust has very little effect upon its operation, whereas quite the contrary is true of an ordinary pipe organ.

### THE LUMINAPHONE

This queer-looking arrangement resembles a cross between two perforated steel mushrooms and four hairdressers' appliances designed for creating a permanent wave. The mushroom-like arrangements are nothing more or less than curved discs of steel mounted on spindles and so arranged as to be rotatable at a constant speed of 400 revolutions per minute. The surfaces are perforated with regular rows of holes, some of them spaced a little further apart or a little closer together than others. A very good idea of the appearance of this instrument can be obtained from the photographs and line drawings given on the opposite page. The parts of this instrument that reminded us of a hairdressing parlor were merely several series of small lamp housings, all of which were arranged in a definite sequence and tilted at a certain predetermined angle. The purpose of this arrangement can be seen from the later description.

In this working model, a small keyboard was mounted on the table directly in front of the whirling discs and every key on that board was a switch which would close and open a circuit when pressed and released. And then, besides the whirling discs, the lamps and the keyboard, there was a standard audio frequency amplifier of the resistance coupled type, such as that familiar to all radio enthusiasts, and connected to the output of this amplifier was a loud speaker of conventional design and make.

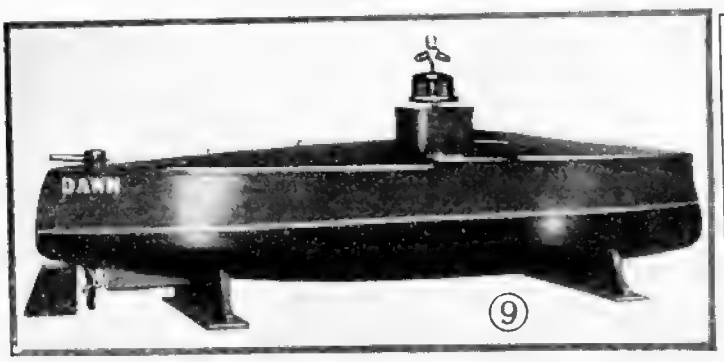
### MODE OF OPERATION

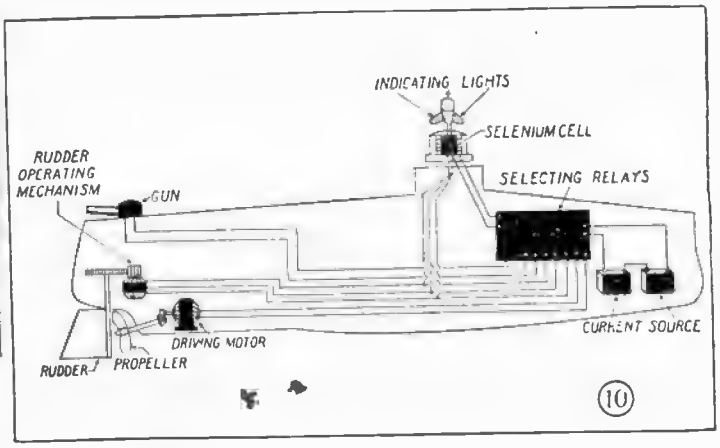
Before discussing the mode of operation of this musical instrument, let us harken back to the days when we studied physics in college or high school. One of the usual pieces of apparatus in a physics class room is a steel disc mounted upon a spindle and equipped with a handle by means of which the disc can be rotated rapidly. The surface of the disc is perforated much in the same way as the disc shown in our illustrations, and by rotating the disc and directing a current of air from a tube onto one of the rows of holes, a musical note could be produced. By blowing the air against a different row of holes, another note could be heard. This effect was produced by the breaking up of the column of air at regular and definite intervals by the disc. Something very much on this same order happens in the *Luminaphone*. Beams of light are directed upon the surface of the disc and when this beam is in line with a hole, the light passes through, but when in line with the solid surface of the disc, the light is cut off. Directly below the holes, and so placed that all of the lamps above it are focused directly upon its surface, is a light sensitive or selenium cell. This cell receives a series of impulses of light and operating through a vacuum tube which acts as a relay and a series of vacuum tubes which act as amplifiers, it produces variations of an electrical current which correspond exactly to the frequency of the light pulsations impressed upon the surface of the cell. The varying electrical currents are, after being amplified, fed into a standard loud speaker and reproduce a note equivalent in frequency to the number of times per second that the light was interrupted by the revolving steel disc. Thus it can be seen that the tone or tones produced by this instrument are directly dependent upon the positions of the perforations on the surface of the revolving discs and upon the speed of revolution as well as upon the number of lamps which are lighted at any one particular moment. The exact action of this novel musical instrument which Mr. Matthews hopes will replace pipe organs to a very great extent can be seen by studying Figs. 1, 2, 3, 4 and 5 on the opposite page. It will be noted that the various lamps are controlled by the keys on the keyboard, there being one key for each lamp. The number of lamps and keys can be increased to include practically any number of notes that are desired.

### NEW PHONOGRAPH REPRODUCER

After studying the *Luminaphone* carefully and watching it in operation, we next viewed a piece of interesting apparatus reposing on

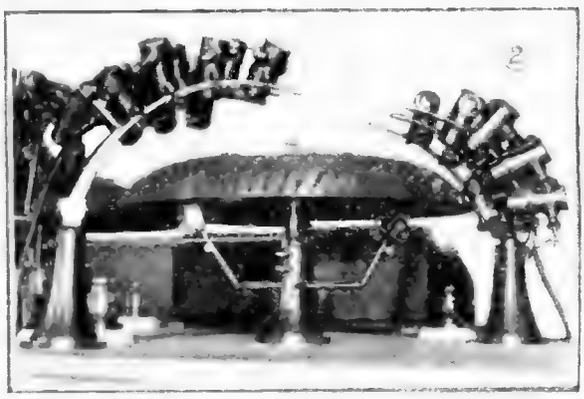
(*Continued on page* 959)



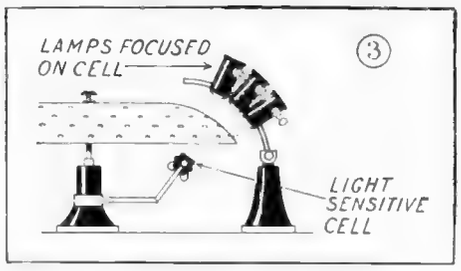




**Above: A view of the light-controlled boat invented by H. Grindell Matthews. The line drawing at the right gives a very simplified view of the apparatus used in a boat of this nature, and also indicates the way in which the various parts are electrically connected.**

The photo at the left shows H. Grindell Matthews at the keyboard of the original model of the Luminaphone, his latest invention. This device uses light rays focused upon a selenium cell to produce musical tones. The light rays are interrupted in order to give this effect, the perforated steel disks providing the interrupting medium. They are mounted on spindles and rotated in synchronism with each other. On the opposite page will be found a complete description of the operation.

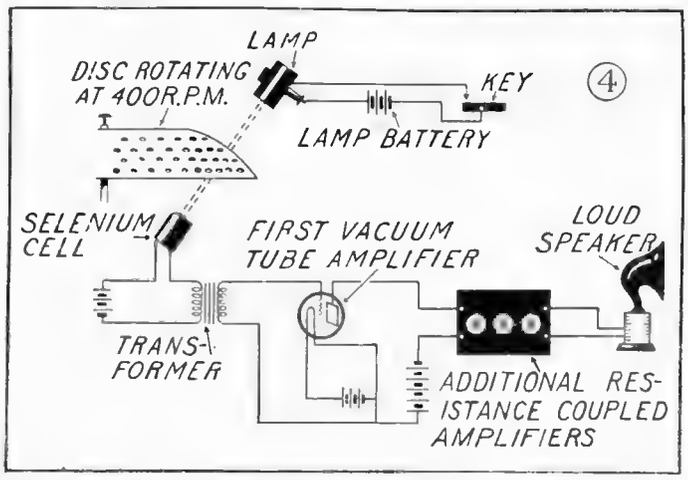


The photo above shows a close-up view of one of the rotating disks of the Luminaphone. Note the two light-sensitive selenium cells mounted on the ends of an arm and located directly under the rotating disk.



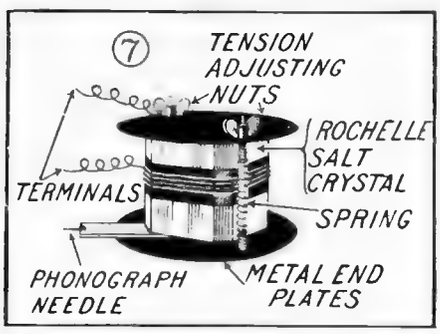

The drawing above shows how a series of lamps are focused through the rotating steel disk on the surface of the selenium cell. By using this system of arranging the lamps, a comparatively small number of light-sensitive cells are employed, yet the over-all efficiency of the musical instrument is great. The variations in strength of the pulsations of light reaching the surface of the cell produce different notes and harmonics which are then amplified and rendered audible.

The drawing at the right shows the essential details regarding the operation of the Luminaphone. A lamp, controlled by a key and lighted by a local battery, is flashed on and off. It is focused on the selenium cell and the light from it is interrupted periodically by means of the rotating perforated steel disk. Pulsations are set up in the selenium cell and are then passed through a cascade vacuum tube amplifier. The loud speaker reproduces the vibrations in audible form. The result is a note not unlike that of a pipe organ. Tones and overtones can be produced with a most wonderful effect.

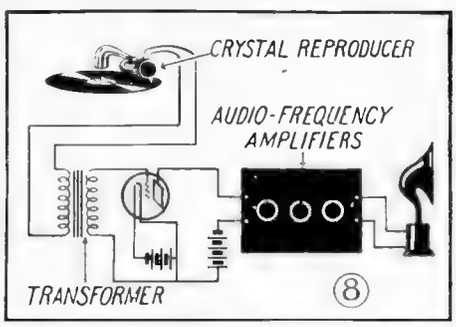


The amplifier used in connection with the Luminaphone in its experimental stage is of typical British design and is illustrated in the photograph above. The input is through a transformer and then follow several resistance-coupled amplifier stages.

The photograph directly below shows the appearance of a standard phonograph equipped with the new type of crystal reproducer developed into a commercially practical form by H. Grindell Matthews. The fundamental theory of this type of reproducer is not at all new, as is mentioned in our article, but the fact remains that Mr. Matthews has made one of the first ones to appear in the commercial field, in competition to the usual type of mechanical or electrical reproducer. This device was heard in operation by the writer and it rendered the best reproduction of a phonograph record that he had ever heard. Tremendous volume was made possible by amplifying the A.C. generated by the crystal. Using resistance-coupled amplifiers, no distortion was detected.



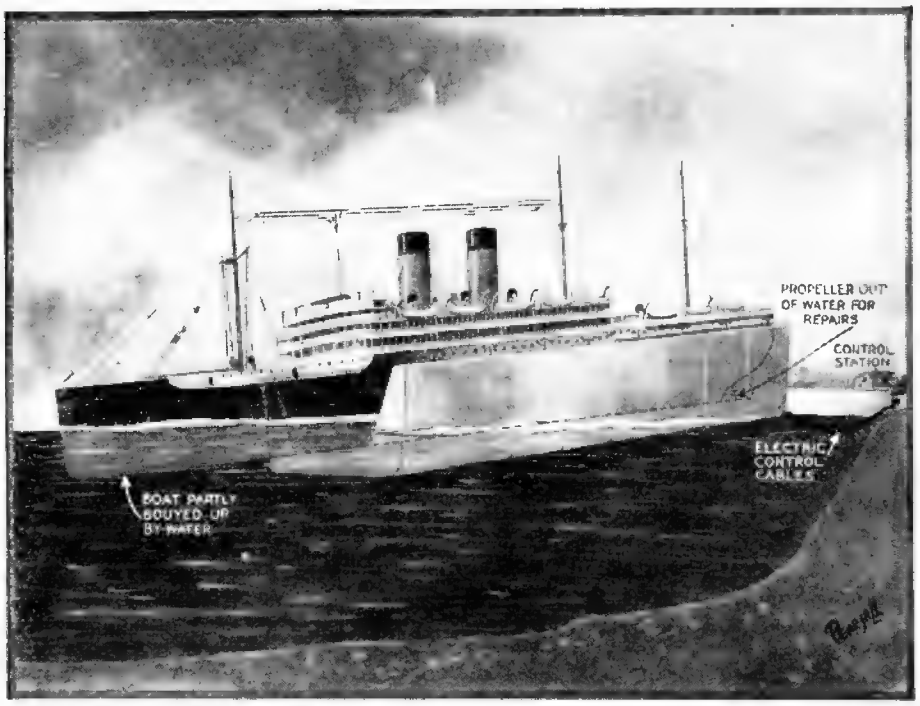

Above we show the principle, piezo-electricity, underlying the crystal reproducer for phonographs. The torsion effects set up in the crystal generate an alternating current of varying intensity which can be amplified and reproduced.




The above diagram shows how the crystal reproducer is connected to an amplifier. Note that no local battery is employed in the crystal circuit inasmuch as the crystal itself is an A.C. (alternating current) generator.

# How Floating Drydocks Operate

FLOATING drydocks are not very well known to the general public and the information given herewith was obtained in a recent interview with Mr. William T. Donnelly of New York City, well-known builder and designer of these remarkable pieces of marine architecture. A floating drydock is used in preference to a solid basin, because it may be moved from place to place whenever so desired, and because it possesses a number of operating features not obtainable with a solid basin or shore type of drydock. Just to cite one instance of the versatility of the floating type of drydock, imagine for a moment that you were faced with the problem of making repairs on a ship which weighed 28,000 tons and that you only possessed for the purpose a drydock having a capacity of 20,000 tons. How would you raise this boat out of the water if you had to overhaul the propellers and rudder? It can be done with a floating drydock as will be explained anon.




When it is necessary to make repairs on the propeller or rudder of a large vessel, it is not necessary to lift the whole boat. Only part of it need be out of the water as shown. Fig. 3.

The sectional drawing, Fig. 1, A, B and C, shows how a floating drydock is submerged by filling its compartments with water, so that the inner floor surface is lower than the keel of the boat to be drydocked. When the drydock has been sunk lower than the keel of the boat, the boat is warped into the drydock by tugs or else by winches and cables, but rarely under its own power, as it creates too much commotion in the water.

When the vessel has been floated into the drydock, the orders are given to start pumping the water out of the buoyancy chambers and it gradually rises. The bilge blocks, which come up under either side of the vessel, are manipulated from above by means of lines and suitable control gear. The intermediate and final stages of raising the ship with a floating drydock are shown at Figs. 1-B and C.

In the illustration at Fig. 2, the general arrangement of a typical floating drydock is shown. The drydock is held flexibly, yet firmly, in position near the shore in most cases, which enables the pump motors for emptying and filling the various buoyancy chambers to be operated by electric power, carried in cables from the shore control station. The chief operator in control of the drydock during its lifting and other operations, is located in a building which overlooks the top of the drydock and from which he can, with a pair of binoculars, see all of the motor pump speed indicators at any instant. In front of him are a series of electrical controllers by which the speed of any of the buoyancy compartment motors can be regulated. If he so desires, there is a master controller whereby he can cause, at the throw of a switch handle, all of the pump motors to work in unison.

The illustration at Fig. 3 shows how a vessel longer and heavier than can be handled by the drydock ordinarily may be partly lifted from the water, so that repairs can be carried out on the damaged part, in this case the propellers and rudder. One of the greatest games in the world is that of handling a floating drydock, for the chief operator or engineer in charge can, by a slight indiscretion, cause the drydock to tilt up at one end and throw the boat outward, which would be likely to severely damage the hull; and if the boat should sink, a pretty expense would be involved in raising the sunken vessel before it could be temporarily repaired and drydocked. A naval engineer once had a large vessel in one of these floating drydocks, and after giving an order his hair almost turned white in one minute when he saw the drydock quickly take a slanting position, with one end considerably higher than the other, which almost threw the boat out of one of the ends.

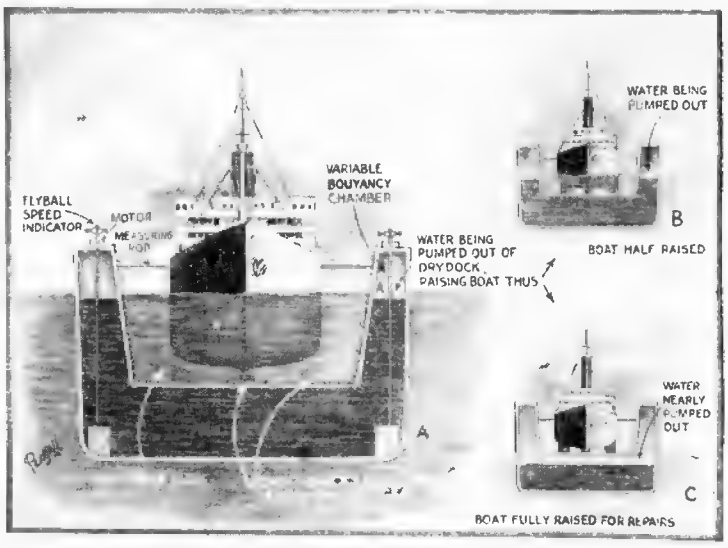
One peculiar thing about these floating drydocks, which are divided off into many separate compartments, each of which can have the water pumped out individually when desired, in order to increase the buoyancy, is that they are more sensitive in a lengthwise direction than they are crosswise.

In the illustrations the struts shown between the deck line of the vessel and the sides of the floating drydock are not heavy beams to help hold the vessel steady as it rises with the drydock, but are simply measuring rods used to ascertain when the vessel is centered in its position on the drydock.

The art of operating drydocks, and it is an art, is not the commonplace and mediocre study that one might thing it to be offhand. Quite the contrary is the case and it only needs a perusal of the following paragraphs in this article and a study of our illustrations to show this to be entirely true. Students of this subject will find much of interest.

Some of the most interesting engineering problems one could find are encountered in the drydock game, as Mr. Donnelly pointed out. If you want to consider a real engineering problem, that shown in Fig. 4, which illustrates a proposition this engineer had to contend with in short order, should prove interesting. A large steam derrick, as well as a huge caisson, had to be raised with a floating drydock, and the only way to tackle this problem correctly was to ascertain the center of gravity of each of these two heavy weights, the total of which was near the maximum lifting capacity of the drydock. How would you go at such a problem? Here's the way it was solved and the two heavy structures lifted successfully with the floating drydock. Blueprints of the steam derrick and the caisson were obtained from the Navy Yard engineers involved in this case, and the various masses and weights of each part of the structures were carefully checked up and the center of gravity of each structure determined. Once these true centers of gravity of the two masses, totaling about fifteen to twenty thousand

The three drawings at the right illustrate the workings of a drydock. First the dock itself is sunk by filling it with water. Then the ship is maneuvered into the dock and electric pumps are started in operation. Thus the water is removed from the dock till the boat assumes the position shown at B and finally is totally out of water as at C. Fig. 1.

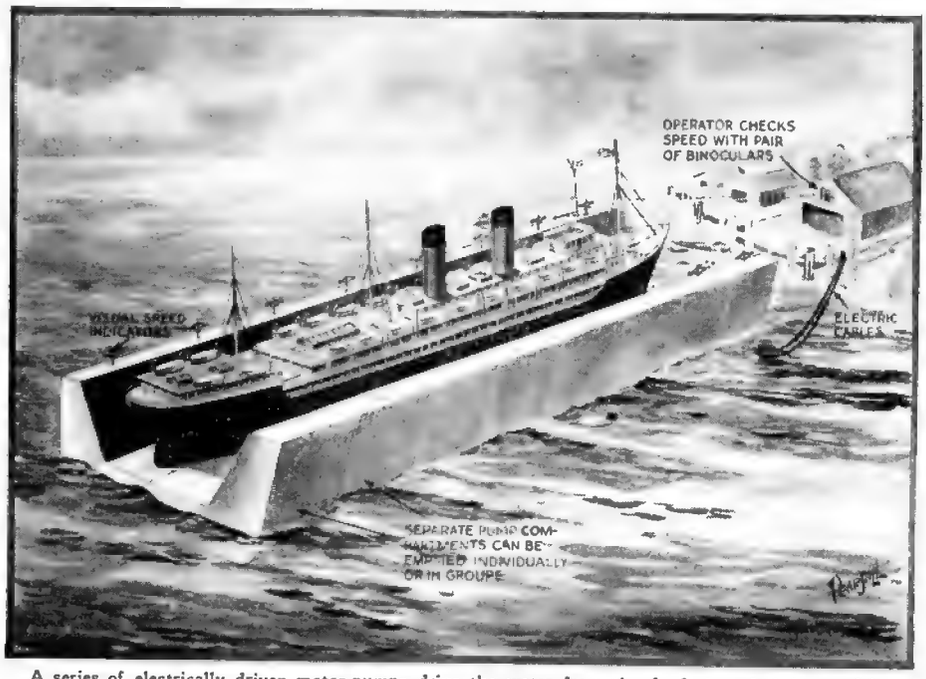


tons, was known, the engineer in charge could specify where each should be placed on the submerged drydock before starting to pump out the water, so as to increase the buoyancy and raise them. The engineer's calculations came out as he expected and the caisson as well as the steam derrick were successfully drydocked on schedule time.

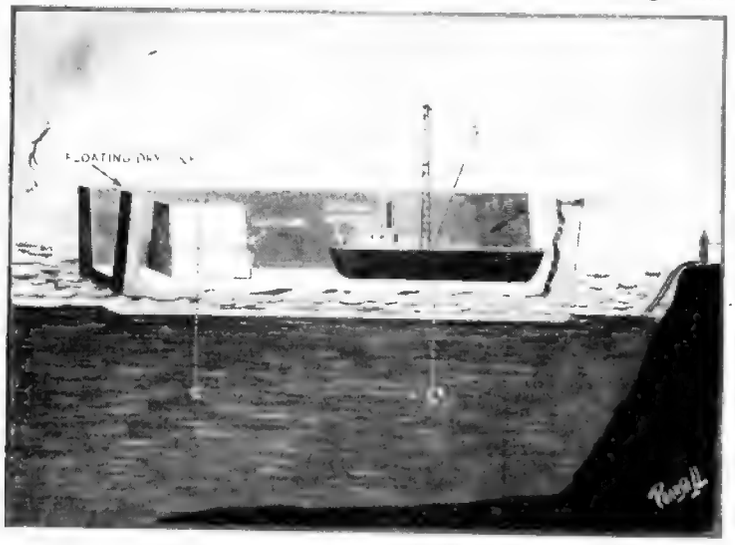
While all sorts of improvements have been introduced in the construction and mechanism of drydocks, they present a peculiarly good opportunity for utilizing electric power. There are some interesting features in the operation of these structures which are especially noticeable in the smaller ones. To prevent the ship from overturning when she rises out of the water, what are known as bilge blocks are used. These slide back and forth at right angles to the keel of the boat on runways on the floor of the dock. They are built up according to the shape of the ship and are made up of very large square pieces of timber, or blocks of wood, as they may be called, placed one on top of the other and held in place with what the shipbuilder calls dogs, a sort of heavy iron staple which is driven in with a maul, one end in each of two adjoining blocks. These blocks may be three feet and more in length and with a minimum of about twelve inches square, and may be much larger. They may be built up to four or five feet in height or more. It is evident that they will be very heavy. They are held in place by a sort of slide, so that they can neither rise nor descend, but can move laterally. If the dock has no water in it it takes very great force to slide these heavy blocks along their none too smooth runway. But they are never moved except for some especial reason or else when there is water in the dock. When the dock is filled with water, which means, if it is a floating dock, that it has been sunk to a proper level, the wooden blocks are buoyed up by the water so that they hardly press against their runway at all, perhaps even against the holding-down strip, a part of the groove which prevents their rising. Thus floated, they move so easily that a man at the end of a rope can slide them in against the ship's bilge. As they are drawn in they bump against the vessel with a sort of thump and that indicates that they are "home," and the ship is resting with the blocks supporting it securely, preventing it from overturning as the water leaves it.

To paint the bottom of the ship, of course, requires it to be out of the water. The bilge blocks cannot be moved back until the dock is filled with water. In the painting of a bottom of a ship there are small areas covered by the bilge blocks that have to go unpainted; so that when a ship leaves a dock she has on the bottom a number of unpainted bits about a foot square, which are designated as "holiday spots."

One of the greatest propositions in the direction of drydocks was to have one which could be moved upon rails like a gigantic railroad car. The ship was to be floated into this, secured in position, then the ship and dock, when water was withdrawn, were to be transported across the land. This was suggested with the view of crossing the American Isthmus. To poise the ship in the drydock instead of the small primitive bilge blocks, it was proposed to have a set of hydraulic rams, whose ends would butt against the ship and the water was to be pumped into all the rams from the one source so that every ram would be pressed against the side of the ship with identical pressure per square inch of its area and held there immovable. Nothing can poise a ship so exactly and with greater mathematical precision than the water in which it floats. But it is probable that no one ever gave very serious thought to the idea of carrying a drydock full of water across the country.


OPERATOR CHECKS SPEED WITH PAIR OF BINOCULARS
VISUAL SPEED INDICATORS
ELECTRIC CABLES
SEPARATE PUMP COMPARTMENTS CAN BE EMPTIED INDIVIDUALLY OR IN GROUPS

**A series of electrically driven motor-pumps drive the water from the drydock and their speed is controlled from land. Flyball speed indicators are positioned as shown. (Fig. 2.)**



**A difficult engineering problem was recently solved as described in the text and illustrated at the left. A derrick and a caisson had to be raised in a floating drydock and by calculating the centers of gracity C1 and C2, this was accomplished successfully. (Fig. 4.)**

Instead of drydocks, marine railroads are often used for smaller vessels. The ship is floated over a cradle with its own bilge blocks drawn in as already described, and rises out of the water upon dry land for painting or repairs. The cradle and ship are carried on an inclined railroad. It will be seen that the marine railroad which has been in use for many generations suggested the idea of transporting ships across the isthmus between the two Americas. The hydraulic rams operated from one source of pressure is the principal original feature which is applicable to present-day drydocks. In operating any such system each ram should be provided with a valve on the inlet so that once it is solidly pressed against the side of the ship the closing of the valve will make it absolutely fixed.

# Offers a Safety Device

SUBMARINES could be made as safe as surface boats but for the indifference of the Navy Department to safeguarding the lives of the crews, said Anthony J. Griffin, Representative from the Twenty-second, New York City, District, in an interview recently.

"It is ridiculous to talk of doing away with submarines as instruments of war," he said, "although they should unquestionably be made safer by the adoption of every possible device to avoid tragedies like those of recent months. The Navy Department has shown an extraordinary lack of foresight in its failure to install the simplest means to protect the lives of the submarine crews."

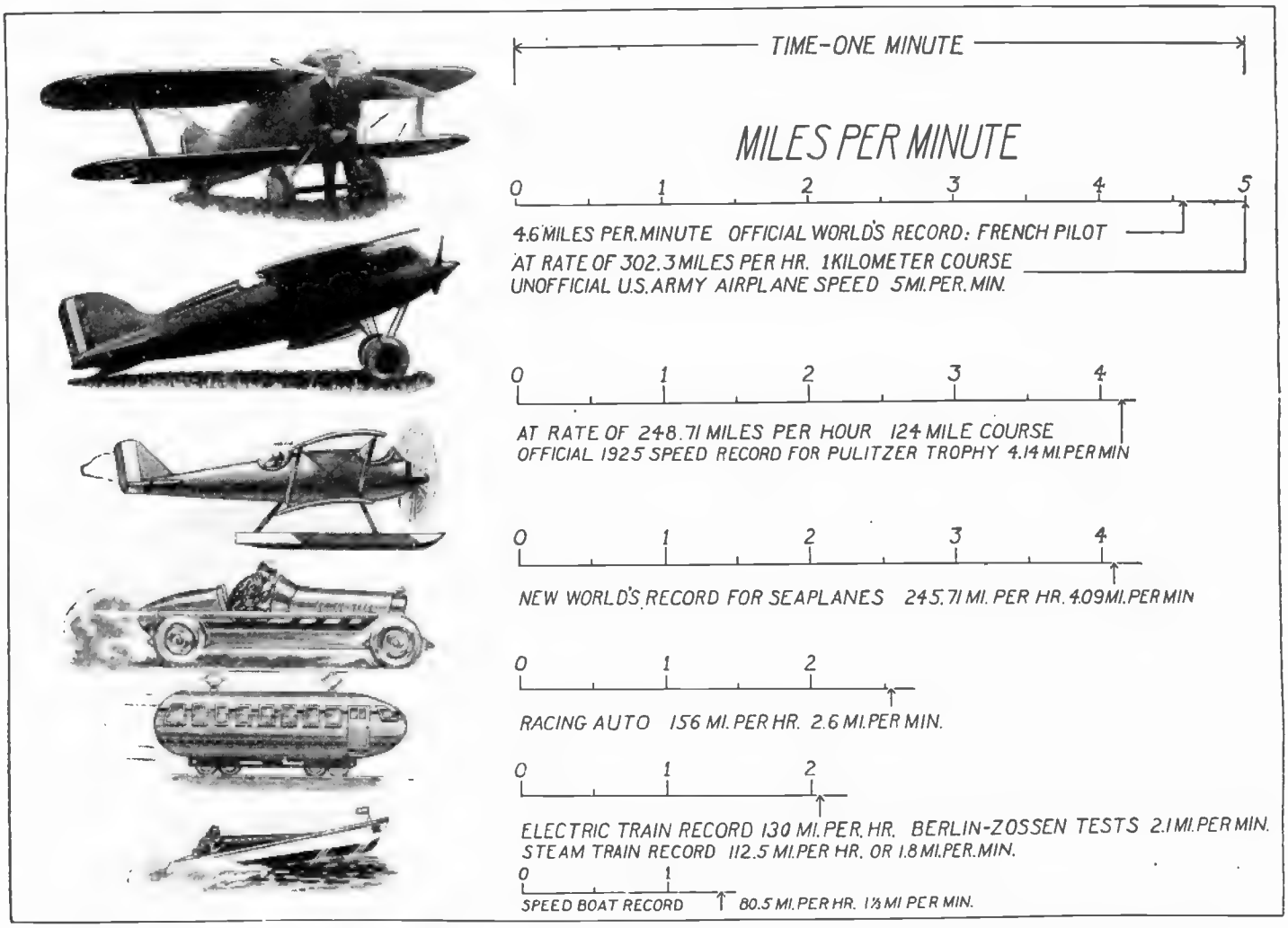
Mr. Griffin told of an invention of his, patented in 1914, which, he said, would provide means of escape from a flooded submarine. The device consists of a series of buoyant safety chambers, placed between the hull and the super-structure of the submarines, which may be entered from below and floated to the surface by means of a releasing apparatus within the chamber. These chambers, said Congressman Griffin, may be of any size or number and can be so placed as not to affect in any way the lines of the boat.

Mr. Griffin also pointed out that the installation of rings on submarines would facilitate the raising of the boats by grappling hooks and obviate the delay and difficulty involved in raising them with chains wrapped around the entire hull.

The Griffin safety chambers would represent the parachutes carried on airplanes, and whose absence had much to do with the loss of life on the *Shenandoah*.

# Flying Five Miles Per Minute

By H. WINFIELD SECOR


TIME-ONE MINUTE
MILES PER MINUTE
0 1 2 3 4 5
4.6 MILES PER MINUTE OFFICIAL WORLD'S RECORD: FRENCH PILOT
AT RATE OF 302.3 MILES PER HR. 1 KILOMETER COURSE
UNOFFICIAL U.S. ARMY AIRPLANE SPEED 5 MI. PER. MIN.
0 1 2 3 4
AT RATE OF 248.71 MILES PER HOUR 124 MILE COURSE
OFFICIAL 1925 SPEED RECORD FOR PULITZER TROPHY 4.14 MI. PER MIN
0 1 2 3 4
NEW WORLD'S RECORD FOR SEAPLANES 245.71 MI. PER HR. 4.09 MI. PER MIN
0 1 2
RACING AUTO 156 MI. PER HR. 2.6 MI. PER MIN.
0 1 2
ELECTRIC TRAIN RECORD 130 MI. PER. HR. BERLIN-ZOSSEN TESTS 2.1 MI. PER MIN.
STEAM TRAIN RECORD 112.5 MI. PER HR. OR 1.8 MI. PER. MIN.
0 1
SPEED BOAT RECORD 80.5 MI. PER HR. 1⅓ MI. PER MIN.

**Comparison of speediest man-carrying vehicles on earth. Unofficial auto speed made by Sig. Haugdahl is 180 miles per hour or 1 mile in 19.9 seconds.**

THE fastest speed at which man has ever moved over the face of the earth was reached a few months ago when Lieutenant Alvord J. Williams of the U. S. Navy flew his blue and gold airplane through the air over a one kilometer course at Mitchell Field, at a speed of 302.3 miles per hour. This was five times faster than the speed attained by the average express train and faster than man had ever traveled before. While we can rely on the measurements of the speed which were carefully made with the latest type electrical recording chronometers this record did not conform to the international aerial speed race requirements because this tremendous and unexcelled speed of 302.3 miles per hour was reached after making a steep dive just before straightening out and flying across the one kilometer course.

The nearest approach to this rate is the official world's record for a one kilometer course held by a French pilot, his speed having been 278 miles per hour, or 4.6 miles per minute, as shown on the accompanying graph chart. In the mighty aerial contest staged a short time ago for the possession of the Pulitzer trophy, a new official world's speed record for a one hundred and twenty-four mile course was established by Lieutenant Cyril Bettis, U. S. Army flyer, who hurled his black and gold Curtiss 'plane around the course at an average speed of 248.71 miles per hour, or 4.14 miles per minute.

The best way to realize what these tremendous speeds mean for military and other requirements is to time yourself when riding along on a trolley car, steam train or automobile, and consider the extent of country you travel over in a distance of five miles, and then by comparison with your watch you will see that the plane has to travel at an unbelievable velocity to cover such a distance as four or five miles in sixty seconds.

A new world's seaplane speed record over a straight-away course was established on October 27th, when Lieutenant James H. Doolittle, of the U. S. Army, flew at the rate of 245.71 miles per hour, or 4.09 miles per minute. This is a truly remarkable speed which Lieutenant Doolittle attained, considering that the plane was encumbered with pontoons. The way these speed races are clocked and averaged is based on the flight along the course an even number of times in each direction; in other words with and against the wind. The speeds for each flight along the course are totaled and then divided by the number of flights which gives the average figure.

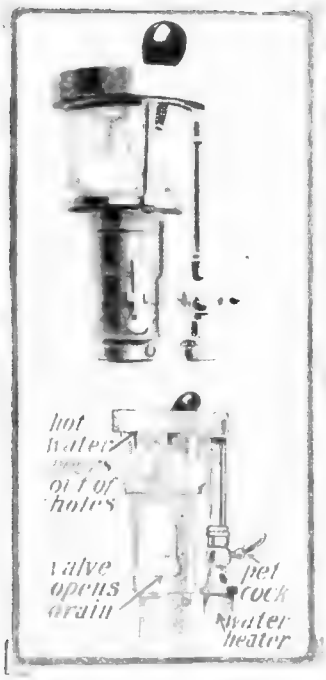
The next fastest passenger vehicle to an airplane is the racing automobile, which has sped along at a speed of one mile in twenty-three seconds, or at the rate of 156 miles per hour. The next fastest speed record for a vehicle carrying a man is the electric train record obtained in the famous Berlin-Zossen test about twenty-three years ago when, after trying all sorts of different shaped windshields on the front of the car, a speed of 130 miles per hour was attained. This is at the rate of over two miles per minute, and appears on the graph. For those interested in the performance of this electric high speed car under the various conditions in the test carried out by the engineers, and which is the fastest train record that we know of, one can find in the Public Library a classic work covering these tests.*

The fastest speed at which a steam train has traveled over the rails is recorded as 112.5 miles per hour, or 1.8 miles per minute. This record, strange as it may seem, was made thirty-two years ago by the Empire State Express traveling over the N. Y. C. and H. R. lines, and this speed has not been approached even remotely in all the ensuing years, except on very rare occasions. The average express train travels at about 60 miles per hour or one mile a minute, while some of the crack trains attain speeds on long straight stretches of 75 to 80 miles per hour. Due to the heavier rails and road-bed required for speeds in excess of these, and also owing to the greater danger of wrecks and wear and tear on the locomotive and cars, we have not seen the long promised 125 to 200 miles an hour train flying across our landscapes.

The speed limit in the airplane world will probably be reached when man flies at 400 to 450 miles per hour, and it is possible that a speed of 500 miles per hour may be attained with the proper design of airplane, flying at high altitudes in rarefied air, where the head resistance is reduced to a minimum.

*Name of book furnished on receipt of stamped envelope.

# Novelties from the Field of Inventions

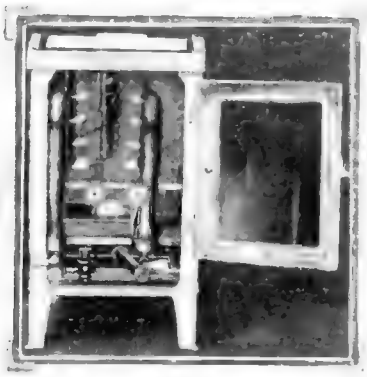



An automatic shaving cup is shown above. Water enters by turning on the petcock and the cup is drained through valve.
—F. C. Darragh.

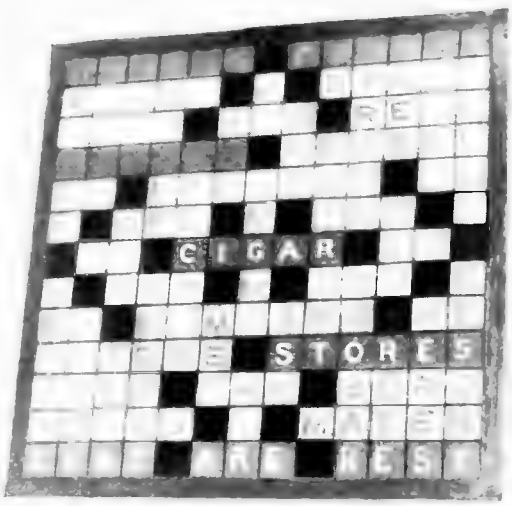
To smoke in comfort while driving a car is something that every smoker-motorist desires to achieve. The cigarette holder combined with a suction cup and a rubber tube as illustrated above makes this possible. The ashes and smoke from a cigarette cannot get into the smoker's eyes.

A new traffic signal light for use by traffic policemen and which is run by a small storage battery has recently been introduced in Boston. The light is strapped to the hand as at the left and two of them are used as above.

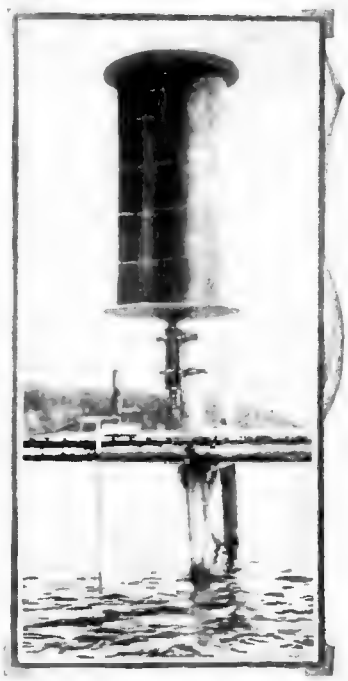
The photograph at the extreme right shows a new type of power rotor that does not have to be driven by hand.



A new broiler, illustrated above, can be attached to any make of gas range.

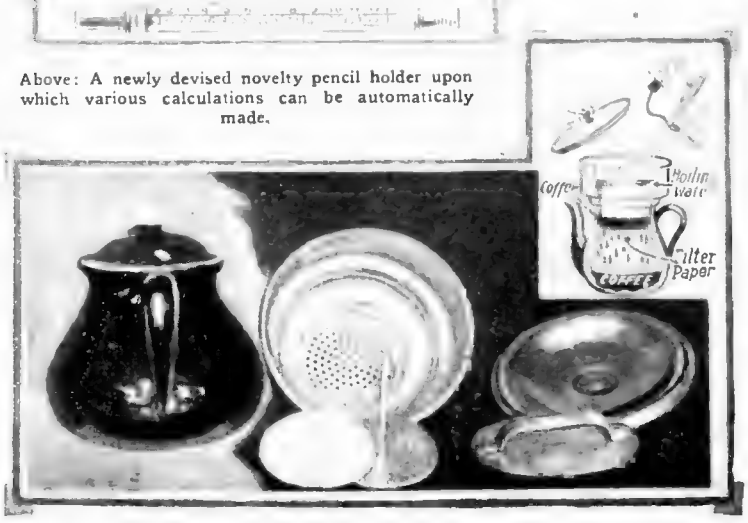



An electrically operated cross-word puzzle which serves as a window display is illustrated above. Advertising slogans are worked into the puzzle as shown.



This new power rotor, designed by a Finnish inventor is shown in operation above, raising water from the lake to a point 50 feet higher.

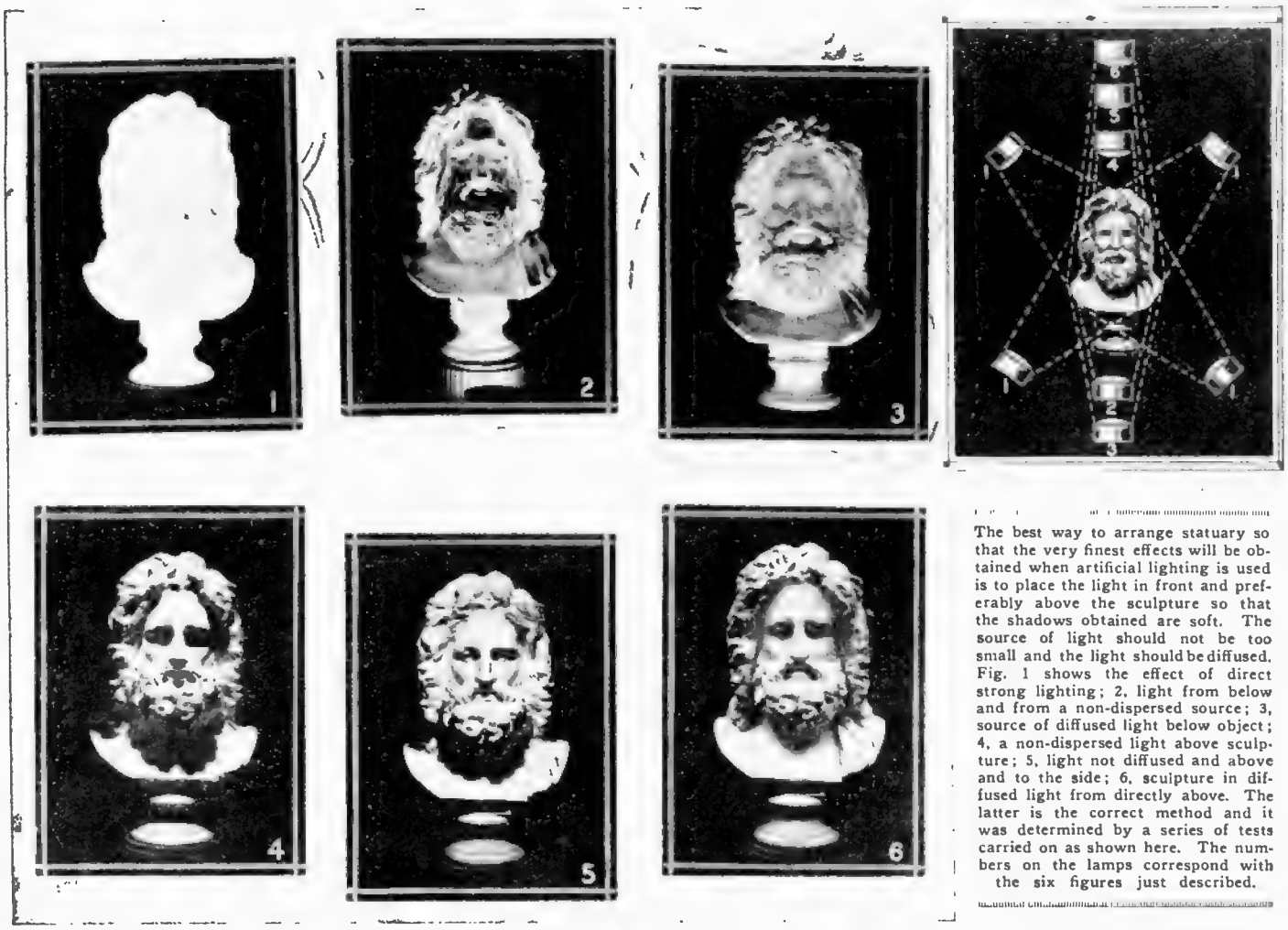
Above: A newly devised novelty pencil holder upon which various calculations can be automatically made.




A new coffee percolator that uses an ordinary pot of the type shown is illustrated in operation and in detail at the left. The action is simple in the extreme and the coffee made with it is perfectly clear and free from grounds. Boiling water is poured in the upper compartment and drips through the ground coffee into the pot. The filter paper is renewed after making the coffee.

New garters made of leather and illustrated here are provided with rubber rings to give elasticity.—Kenneth B. Murray.

# Shadow Effects on Plastic Objects



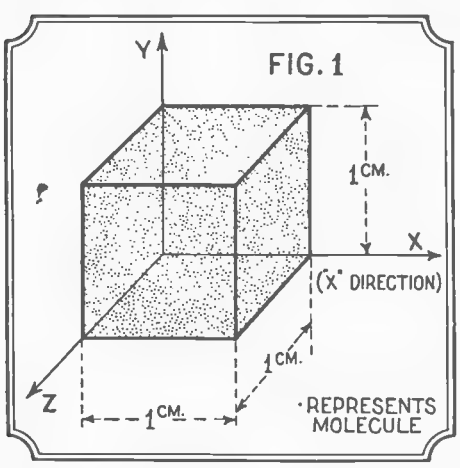

The best way to arrange statuary so that the very finest effects will be obtained when artificial lighting is used is to place the light in front and preferably above the sculpture so that the shadows obtained are soft. The source of light should not be too small and the light should be diffused. Fig. 1 shows the effect of direct strong lighting; 2, light from below and from a non-dispersed source; 3, source of diffused light below object; 4, a non-dispersed light above sculpture; 5, light not diffused and above and to the side; 6, sculpture in diffused light from directly above. The latter is the correct method and it was determined by a series of tests carried on as shown here. The numbers on the lamps correspond with the six figures just described.

# Can You Think Clearly?

**By HARRY R. LUBCKE**

EXPERIMENTERS in science must, as a whole, be clear thinking individuals. Experimentation and scientific study promote clear thinking which is a valuable asset in the business and social worlds as well as in science.

In the realm of theoretical physics the work consists in deriving natural laws by logical, straightforward thinking. There is one demonstration, the derivation of Boyle's Law from the kinetic theory of gases, that is simple in its mathematical aspect and therefore can be grasped by the average experimenter. To follow through this demonstration, thinking it out, is a fine mental exercise.

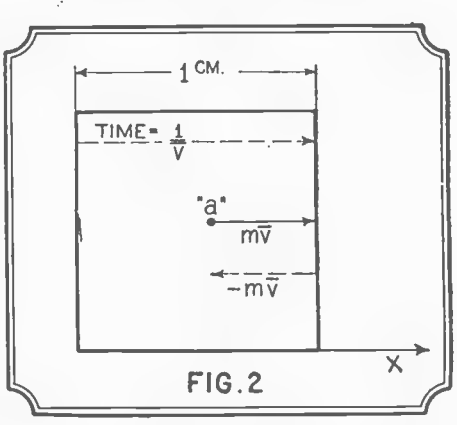



Above: Illustration of cube in which molecules represented as dots are in constant motion.

First of all a brief introduction to the subject will be necessary. The kinetic theory of gases explains that all gases are made up of a great number of widely separated particles called *molecules*, that these particles *are in rapid motion*, and that the pressure of a gas is due to the *innumerable impacts* of these molecules on the sides of the containing vessel. This is a very fruitful theory and has been proven again and again by experimental observations. Boyle's Law is also quite simple. It states that the pressure of a gas multiplied by its volume always gives a *constant* quantity. Thus, if the pressure of a given mass of gas be *doubled*, the volume will decrease to *one-half* the original. It is stated very briefly in symbols, *viz.:* $P \times V = C$ where P is the pressure, V the volume and C a constant

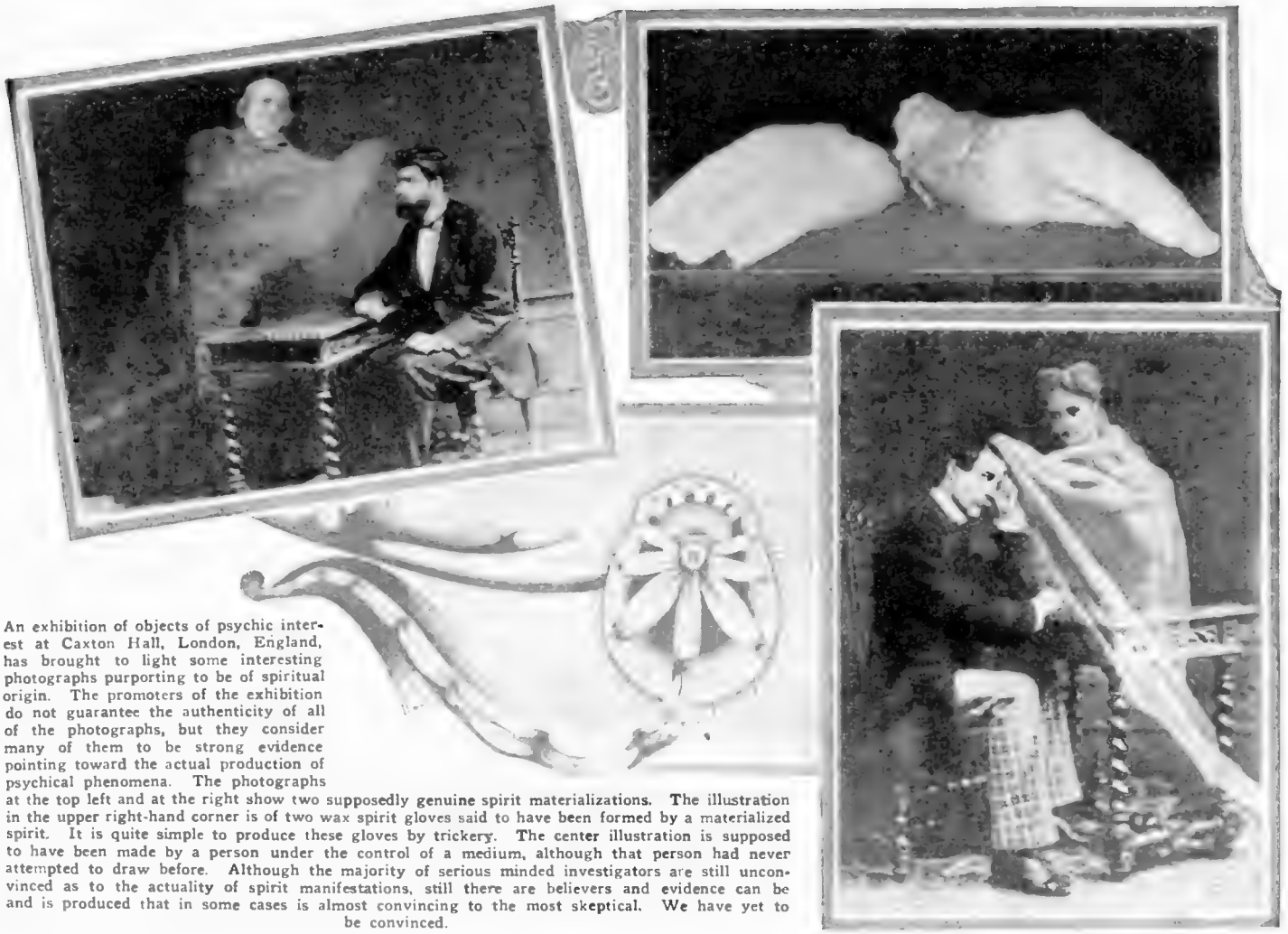
Now for the exercise. (Remove coats, collars, etc.) Remember, the *object* of the discussion is to prove that $P \times V = C$ using the rules of the kinetic theory. First, we will make four necessary and easily justified assumptions. (1) We assume that the molecules obey the laws of mechanics. In other words, that they are subject to gravitational attraction, that they have mass, and in short that they behave like a lot of billiard balls, all of which is quite reasonable.

(*Continued on page* 956)




Above: One side of the cube illustrated in Fig. 1. See text for further explanation.

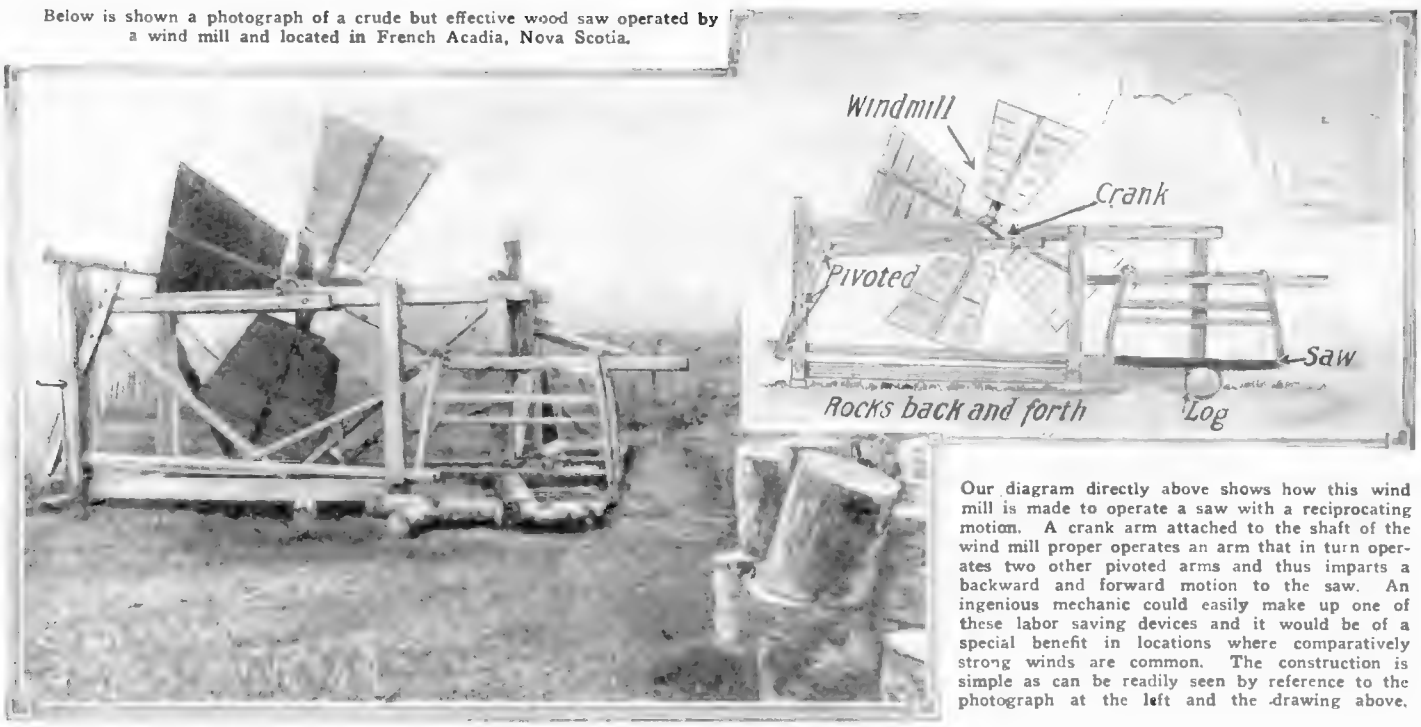
# "Spirit" Photos



An exhibition of objects of psychic interest at Caxton Hall, London, England, has brought to light some interesting photographs purporting to be of spiritual origin. The promoters of the exhibition do not guarantee the authenticity of all of the photographs, but they consider many of them to be strong evidence pointing toward the actual production of psychical phenomena. The photographs at the top left and at the right show two supposedly genuine spirit materializations. The illustration in the upper right-hand corner is of two wax spirit gloves said to have been formed by a materialized spirit. It is quite simple to produce these gloves by trickery. The center illustration is supposed to have been made by a person under the control of a medium, although that person had never attempted to draw before. Although the majority of serious minded investigators are still unconvinced as to the actuality of spirit manifestations, still there are believers and evidence can be and is produced that in some cases is almost convincing to the most skeptical. We have yet to be convinced.

# Sawing Wood by Wind

Below is shown a photograph of a crude but effective wood saw operated by a wind mill and located in French Acadia, Nova Scotia.




Our diagram directly above shows how this wind mill is made to operate a saw with a reciprocating motion. A crank arm attached to the shaft of the wind mill proper operates an arm that in turn operates two other pivoted arms and thus imparts a backward and forward motion to the saw. An ingenious mechanic could easily make up one of these labor saving devices and it would be of a special benefit in locations where comparatively strong winds are common. The construction is simple as can be readily seen by reference to the photograph at the left and the drawing above.

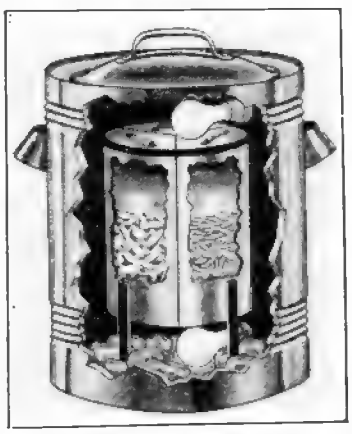
# At the New York

## Novel Applications of Electricity That Bear On

By JOSEPH

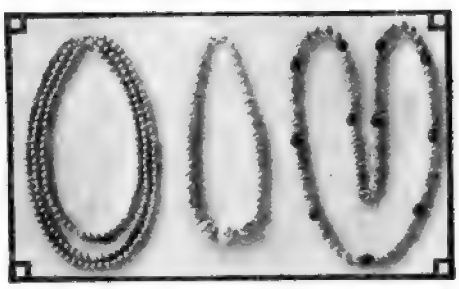
Much of interest is to be seen at industrial shows if one is on the lookout for interesting material and the articles described here were selected as being the most striking and representative of all shown.

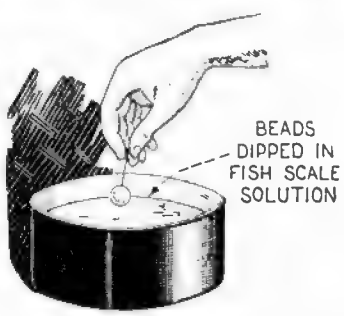
ELECTRIC COOKER AND BAKER. Above: Miss Margaret Corcoran is shown demonstrating a new type of what might be called a fireless cooker. In this device, which can be used for all types of cooking, two electric light bulbs furnish all the heat necessary. One is placed near the top and the other near the bottom, as can be seen above and in the drawing at the right. Cooking can be carried on without the use of water other than that contained in the materials themselves. This method is said to make vegetables in particular more tasty. Even though water is not added to them, they cook in their own moisture and are rendered most tender and nutritious.



The drawing above gives the details of the electrically heated cooking device shown in the photograph in the upper left-hand corner of this page. Separable compartments allow the cooking of different foods at the same time. Cakes can also be baked. The author of this article had one of these cookers sent to the office of SCIENCE AND INVENTION and, using prepared flour, a very palatable cake was cooked in a very short time. It baked perfectly, finishing with a golden brown crust.

BEADS MADE OF BAKELITE. Below: The very latest in decorations for milady. Solid colored bakelite beads dipped in an opalescent solution. Other types of beads have been placed on the market, using the fish scale solution, to obtain an opalescent effect but these are the first that can be considered non-breakable.

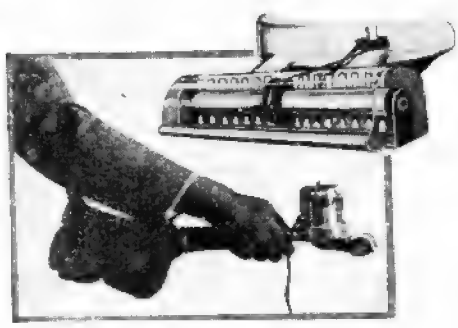





Artificial pearls have been on the market for a good many years, but those that are extensively sold today have many drawbacks, the greatest being their frailty. The glass or wax centered beads are most easily broken, but such is not the case with the beads made of bakelite and illustrated in the photograph at the top of this column. The process of making these beads is simple. Small globules of colored bakelite are prepared with holes through their centers. These bits of material are practically non-breakable and they are then dipped several times into an opalescent solution made up with suspended fish scales. After drying for a day or two between each dipping, the beads are ready for use and are most beautiful, due to the permanent tints afforded by the underlying colored foundation.

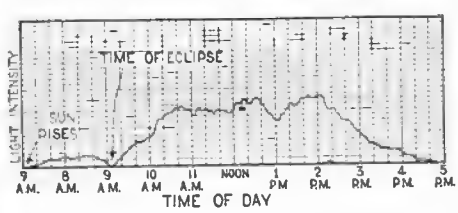
*Photograph courtesy Bakelite Corp.*

GIANT AND MIDGET PRESSING IRONS. The photograph shows two extremes in electrical pressing iron construction. One is so small and well balanced that it is easily handled, but the other one could hardly be moved, much less used.



VACUUM BRUSH. A compact vacuum cleaner, the collecting bag of which is strapped to the arm, is shown in detail above. Operating from an ordinary electric light socket, the brush is small enough to reach many places that could not be cleaned with a standard vacuum cleaner.

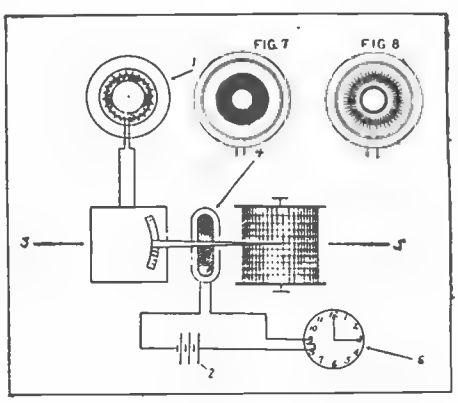
LIGHT INTENSITY RECORDER. A new pyrheliometer used for studying the effect of sunlight on electrical current consumption is illustrated in the photo below. Under the glass case is a thermopile, consisting of 50 thermo-couples electrically fused together.




The pyrheliometer was used for making records during the total eclipse of the sun on January 24, 1925, by the New York Meteorological Observatory. The result is given on the chart shown at the left, indicating that very nearly total darkness was observed during the eclipse period. Note other fluctuations due to clouds.

The circuit diagram of the pyrheliometer is shown at the right. 1 is the thermopile; 2, a battery; 3, a milli-voltmeter; 4, an electro-magnet; 5, a revolving chart, and 6, a clock. As the sunlight varies, the current generated by the thermopile also changes and the arm of the milli-voltmeter, held in contact with and making marks on the revolving chart, moves in accordance with the current fluctuation. The clock is used so as to actuate the instrument over any desired length of time. In the thermopile, the junctions are attached to but insulated from thin concentric copper rings. The outer ring is white and the inner one is black. The black ring absorbs more heat than the white and thus when exposed to sunlight, the thermocouples are actuated. Fig. 7 and Fig. 8 show this construction.

*Photos courtesy New York Edison Co.*



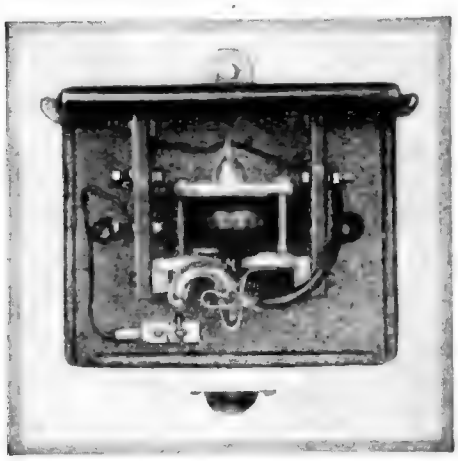
# Electrical Show

## And Insulating Materials Our Everyday Life

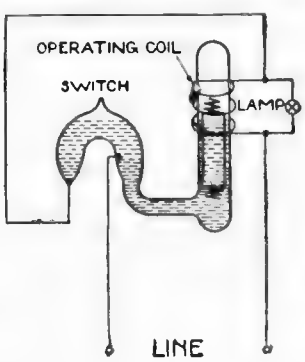
H. KRAUS

Items of interest to the housewife, the home mechanic, the automobile driver and many others were exhibited at the latest New York Electrical Show. We show some of them here.

**ELECTRIC LIGHT FLASHER.** A newly devised type of flasher for electric signs or window displays is illustrated in the photograph and diagram below.
*Photos courtesy Westinghouse Electric & Mfg. Co.*

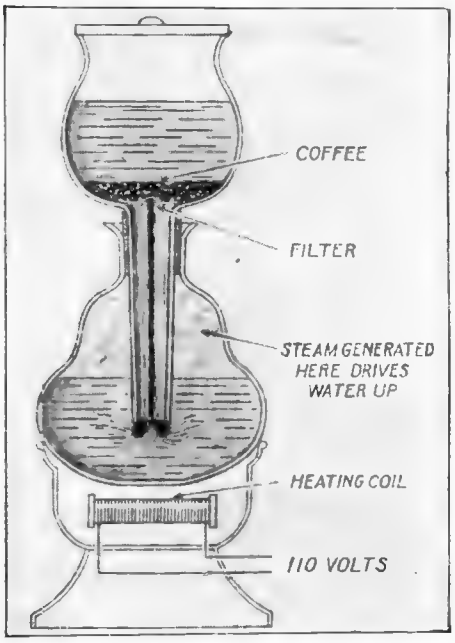


The completed electric flasher in its case is shown in the photograph directly above and the diagram at the right shows its operation.



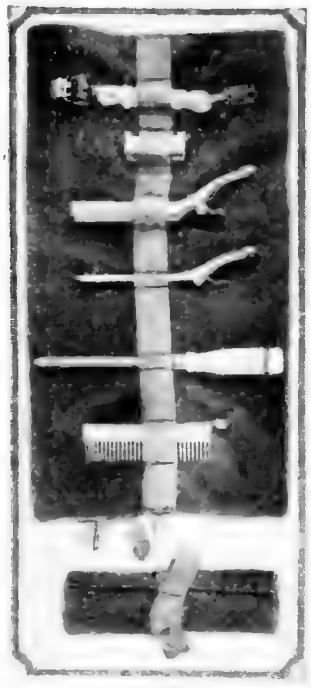

When the current is turned on in this flasher, the core is drawn up into the operating coil and the level of the mercury falls, breaking the contact directly below the point marked "switch." Then the plunger falls, closing the mercury circuit again and the process continues.

**COFFEE MAKER.** Illustration above shows a new and improved type of coffee percolator; the coffee container can be removed and the brewed drink can be poured out from the lower section. Made of glass, with smoothly rounded corners, this coffee urn is most sanitary and easily cleaned. It is quickly disassembled for thorough washing both inside and out. The glass is unaffected by the coffee or the heat.
*Photo courtesy the Frank E. Wolcott Mfg. Co.*



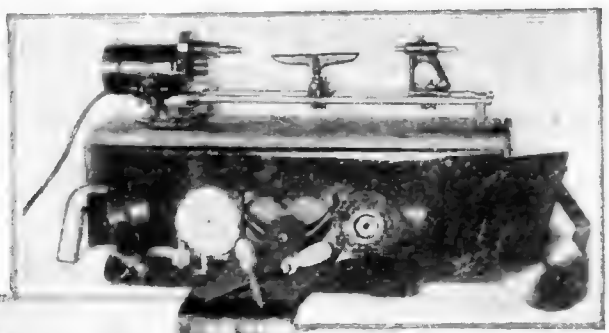

This coffee filter, the elements of which are constructed of a special heat-proof glass, is heated by means of a coil of resistance wire through which a current of electricity passes. The water placed in the lower receptacle boils and gives off steam which increases the pressure above the water and therefore forces it up into the top container. From here, the liquid filters down through the coffee grounds. After all of the liquid has passed from the top receptacle to the bottom, the coffee grounds container is removed and the clear liquid, free from bits of coffee, is poured into serving cups from the lower container. The entire action takes place in two parts, most of the water first passing upward and then after the containers are removed from the heating element, downward through the ground coffee.

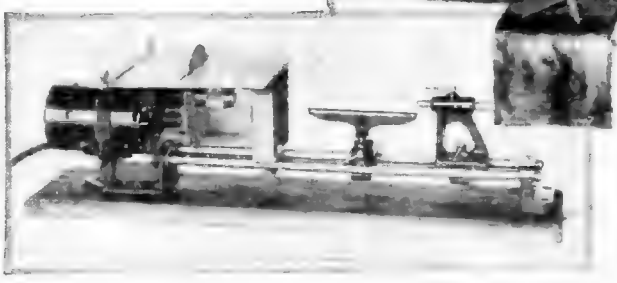
**RADIO PANEL.** Various methods have been devised for decorating radio receiving sets and making them more pleasing to the eye. One of the most recent developments is the inlaid panel shown directly above. Two engraved scales blend nicely with the background which itself is a fantastic land and seascape. The scales are used in conjunction with knobs and pointers for indicating the relative positions of tuning instruments. These make a very nice departure from the conventional dial that is in such universal use today. When judiciously arranged, other instruments requiring variable controls can be mounted on the panel, without detracting in the least from the over all appearance.
*Photo courtesy Bakelite Corp.*



**ELECTRICAL BEAUTY SET.** At the left we show a photograph of a traveler's beauty kit containing a curling iron, a device for marcelling the hair, a drying comb and a handle, connecting cord and cooling stand to be used with any one of the three electrically heated devices.
*Photos courtesy the Frank E. Wolcott Mfg. Co.*

**PORTABLE MACHINE SHOP.** Selling at a most reasonable figure, a complete portable machine shop capable of performing many operations has recently appeared on the market. All of the details of the operating parts and the accessory tools are shown in the photograph at the right. A complete set of tools for various kinds of work is furnished.

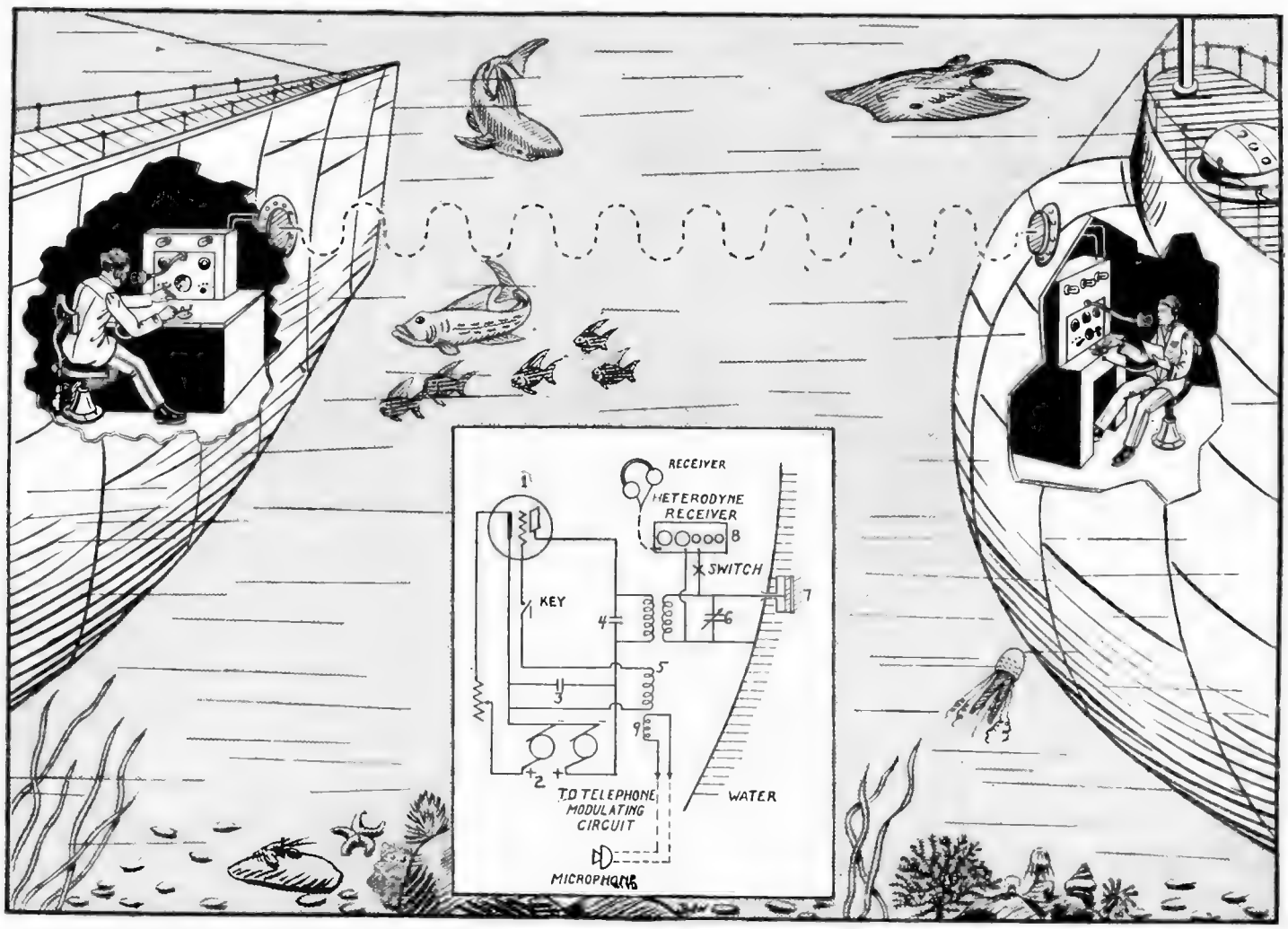




The photograph at the left shows this machine shop ready to saw wood up to 1¾ inches thick. The motor can also be used to drive a buffing wheel, a drill or to machine the parts as a lathe.
*Photos courtesy Electro-Magnetic Tool Co.*

# Submarines Talk by Inaudible Sound Waves

By S. R. WINTERS




The circuit in the center of the above illustration shows how the transmitter and receiver for talking by means of inaudible sound waves are hooked up. The rest of the drawing shows two sets in operation and two-way communication being carried on through the water.

COMMUNICATING under water by means of inaudible sound waves sounds almost like a fairy tale, doesn't it? However, the engineers and scientists connected with the United States Naval Research Laboratory at Washington have worked out a scheme whereby one submarine can talk to another under water, or to a land station equipped with the proper reception apparatus by sound waves, which are inaudible to the present apparatus used by ships and submarines for several years to pick up the ordinary sound waves audible to the human ear.

The human ear can hear sounds as low as about eight vibrations and up to about 30,000 vibrations per second. In a recent report given out by the Naval Research Laboratory, a general statement mentioned briefly that code messages transmitted by under-water sound-telegraphy, using comparatively low frequency sound waves, is well known; while high frequencies, that is, above the limit of audibility of the human ear (about 30,000 vibrations per second), are now being utilized.

We show herewith the first technical diagram released by the Naval Research Laboratory, which will make clear how the apparatus operates. In the diagram, 1 is a vacuum tube provided with filament, grid and plate members; 2 represents a motor generator with both filament and plate potential windings on the generator; 3 is a potential regulating and filter condenser; 4 is the plate circuit condenser; 5 represents the grid inductance coupled electromagnetically with the telephone modulating circuit inductance, 9; a tuning condenser to control the frequency of the outgoing and incoming wave is shown at 6; while at 7 we find the supersonic transmitting and receiving oscillator disc. This acts as a microphone or radiator.

The Heterodyne radio type receiver is shown at 8.

In transmitting, the Heterodyne circuit is opened and a super-audible wave is radiated from the submarine, utilizing the vacuum tube 1 as the source of high frequency oscillations. These are modulated by the voice through the agency of coils 9 and 5.

In the reception of such a super-audible sound wave, modulated by voice or merely interrupted for code transmission, the inaudible sound waves picked up by the oscillator disc 7 are converted into oscillatory currents and are then rendered audible to the human ear, through the agency of a Heterodyne receiver, which acts to set up an audible frequency representing the difference between the frequency of the incoming wave and that set up by the oscillator in the Heterodyne receiver.

It is obvious that a system of this nature will adapt itself very well to sub-sea transmission. It will undoubtedly be of great assistance for intercommunication between submarines and other vessels. The system is most sensitive in operation and therefore is useful over quite a large radius.


## ANNOUNCEMENT

WITH the March issue of SCIENCE AND INVENTION, that well known and popular magazine, THE EXPERIMENTER, will be merged into one big and even more attractive publication with many new departments which were never possible before for lack of space.

Since going over the recent Voting Blanks, showing the preferences of our readers, we are discontinuing several departments, which seem to be of least interest to our readers. In their stead, we are publishing the best features from THE EXPERIMENTER Magazine, principal among which are the following:

EXPERIMENTAL CHEMISTRY
JUNIOR EXPERIMENTER
EXPERIMENTAL ELECTRICS

We know that the combination of these two well-known magazines will result in great satisfaction to SCIENCE AND INVENTION readers, and we trust that the special new departments will be of great interest to each one.

As there will be a very large demand for SCIENCE AND INVENTION, due to the combination of these two magazines, we suggest that you place your order with your newsdealer at once, so that you will not miss your copy of the new and greater SCIENCE AND INVENTION.

# Optical Illusions

By DR. WALTER EHRENSTEIN

FIGURES 1, 2, 3 and 4, illustrated herewith, are squares! That is to say, they are only squares geometrically speaking. As we look at them their sides seem to be crooked lines. In Fig. 5 there is a true circle drawn in a

In the figure at the right a geometrically perfect square is crossed by a series of diverging lines. The square seems to be distorted.

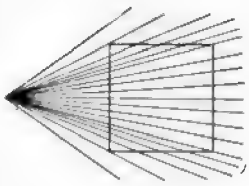


FIG. 1

sheaf of radii, but this circle seems to be flattened on the left side materially, especially when we bring it with the center pointing to us up towards the eye from a considerable distance. Because in this figure the optical perspective gives no true image of the geometrical shape, it is called the phenomenon of geometrical optical illusion.

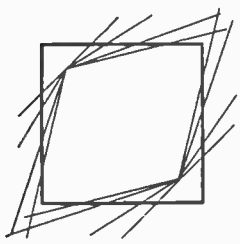


FIG. 2

The heavy line in the figure at the left is another perfect square but to the eye its sides seem to be curved and its angles appear to be acute and obtuse rather than right-angles

In the figures here given it is especially the so-called angle illusion which are treated of. The apparent contours of the squares and of the circle, which suffer curvatures, form with the transverse lines angles, and these angles in analogous illusion are to be recorded as illusion motifs. For many years we have recognized the "principle of the

In the particular case at the right, the perfect square appears to be distorted because of the concentric circles superimposed on the straight lines. The four heavy lines, however, are perfectly true.

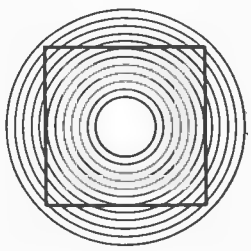


FIG. 3

over-estimation of small angles," which gives the explanation for the inadequate conception of the figures of this kind, although certainly we can't say why small angles must be "over-estimated." Only the more recent investigations into "motion sight," which have been carried out especially in the Frankfort, Germany, Psychological Institute, give an explanation for the reason of the so-

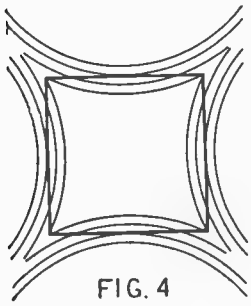


FIG. 4

By drawing a series of curved lines through each side of a perfect square as in the figure at the left, the sides of that square appear to bulge out, but in reality, they are absolutely straight.

called "over-estimation of small angles." Almost all investigators who have concerned

In the particular optical illusion illustrated at the right, a true circle is crossed by a series of diverging lines with the result that the circle itself appears to the eye to be quite distorted. However, removal of the straight lines proves this to be only an illusion.

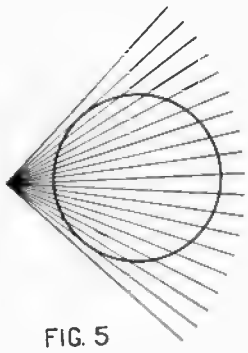


FIG. 5

themselves with the explanation of the illusion of angles, including Helmholtz, Hering and Wundt, agree in asserting that the effect of illusion noticeably increases if the eyes are moved; but by holding them rigid or by an instantaneous illumination by the electric spark under some circumstances the

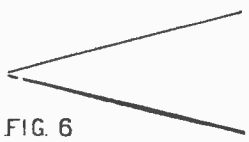


FIG. 6

Many interesting optical illusions can be performed with the little diagram illustrated at the left. See text for instructions.

illusion can be diminished until it completely disappears. Why the movement of the eyes has this effect of increasing the illusion in spite of many theories is absolutely unexplainable. We reach the same increase of the illusion effect which one obtains by moving the eyes, if the figure in front of the stationary eye is moved backwards and for-

Gazing fixedly at the spiral illustrated at the right, rotate the page and the lines will appear to get further apart or closer together according to the direction in which the figure is rotated.

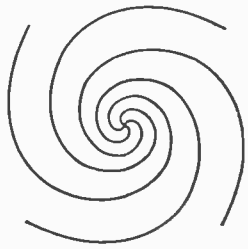


FIG. 7

wards. In both cases the figure's image on the retina inevitably moves about, which can be recorded as an absolute requirement of the illusion and that for the following reason:

As we ordinarily look at an object our eye is never perfectly quiet, but the position for the clearest vision constantly varies within the eye. In our natural everyday obser-

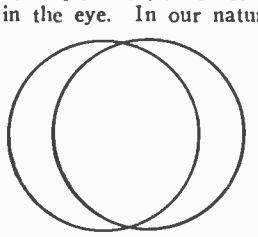


FIG. 8

Here is another rotating illusion. The intersecting circles produce peculiar results if the page is continuously rotated about one foot or less from the eye.

vations of things there is always a movement of the eyes and in consequence thereof a movement of the image on the retina. We can convince ourselves of this easily by direct observation or if we move Fig. 1 or Fig. 5 rather quickly to and fro. Then we see a strong dispersion of the rays by moving them in the direction of their convergence and a noticeable contraction of their angle by moving them in the opposite direction. This dispersion and convergence can be seen

Eccentrically placed circles as shown at the right in Fig. 9 give rise to unusual distortion if the page is rotated. Beautiful effects are often produced in this manner.

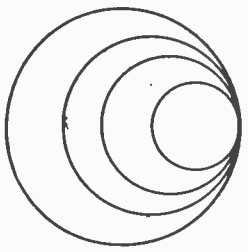


FIG. 9

in the case of a single angle, although in less degree. If one traces out Fig. 6 with a fixed point, such as that of a lead pencil, trying to draw the lines dividing the angle in half, moving the pencil from outwards

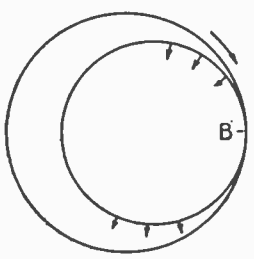



FIG. 10

If the figure at the left is rotated, characteristic illusions of movement similar to those of Figs. 8 and 9 will be produced. Rotate the page in the direction of the arrow to produce the best results.

towards the intersection, the two sides of the angle will seem to move toward each other. But if the point is moved in the other direction, then the angle will seem to expand. This can be explained intelligibly if one pictures to himself what goes on on an isolated segment of the retina during the movements of the pencils in two successive moments. But if the angle is moved from right to left, there is formed upon the retina in what we may call the first moment a por-

And here we have some more circles. At some point, each circle touches one of the others and rotating the page, will produce surprising results surprising optical results. Use phonograph to rotate designs.

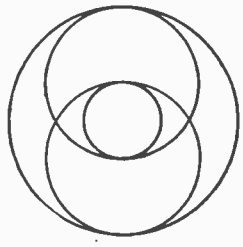


FIG. 11

tion of the outline of the angle, say of the height 1, and in the second moment another portion thereon of the height 2. By moving the angle from right to left besides the phenomena of the movement between what

(*Continued on page* 967)

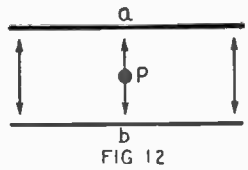



FIG 12

By gazing fixedly at the point P, and moving the page slowly up or down in the direction of the arrows, a back and forth movement of the lines will be seen.

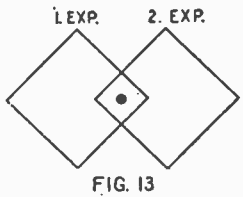
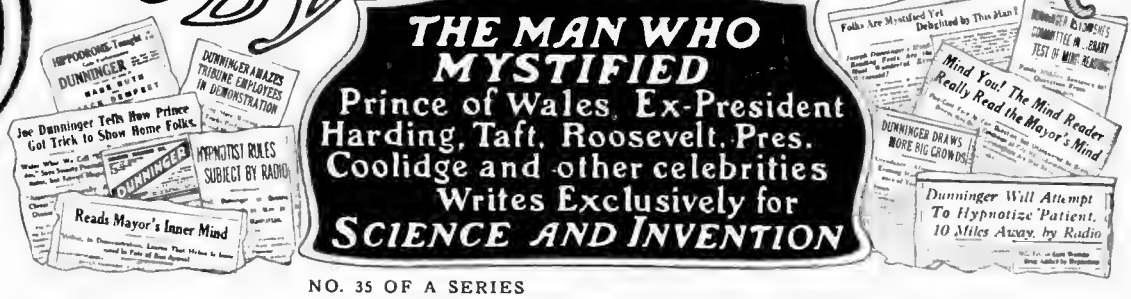



FIG. 13

A peculiar change will take place in the figure shown at the left if the page is moved up and down. See text for complete details.

# MAGIC By "DUNNINGER"

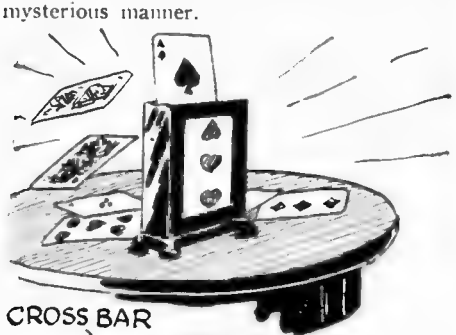
## THE MAN WHO MYSTIFIED Prince of Wales, Ex-President Harding, Taft, Roosevelt, Pres. Coolidge and other celebrities Writes Exclusively for SCIENCE AND INVENTION

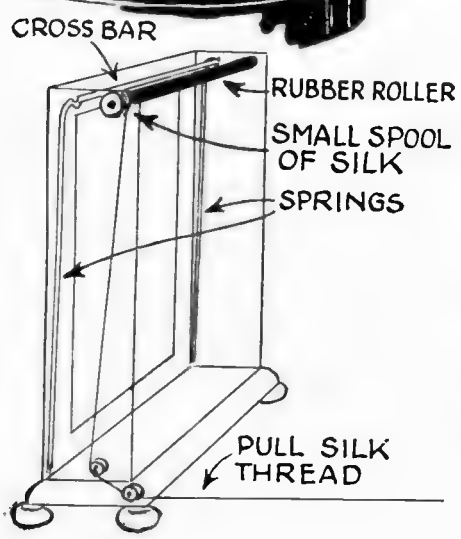

HIPPODROME Tonight
DUNNINGER
DUNNINGER AMAZES TRIBUNE EMPLOYEES IN DEMONSTRATION
Joe Dunninger Tells How Prince Got Trick to Show Home Folks.
DUNNINGER
HYPNOTIST RULES SUBJECT BY RADIO
Reads Mayor's Inner Mind
Folks Are Mystified Yet Deducted by This Man!
Mind You! The Mind Reader Really Read the Mayor's Mind
DUNNINGER DRAWS MORE BIG CROWDS
Dunninger Will Attempt To Hypnotize Patient, 10 Miles Away, by Radio

NO. 35 OF A SERIES

## New Raising Card

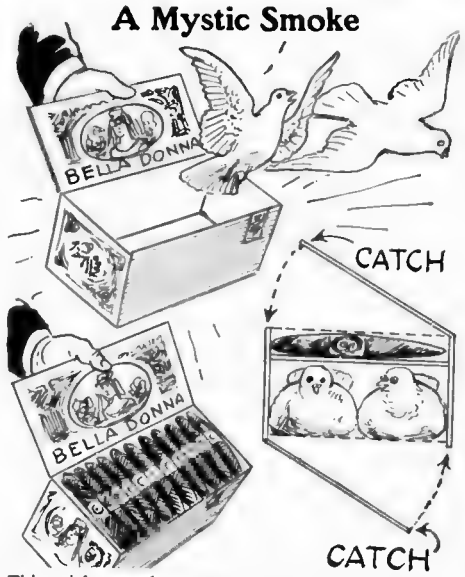
Magicians desirous of improving their programs by adding a piece of mechanical apparatus to their outfit, will find the effect about to be described well worthy of the trouble that will be necessary to build this clever piece of paraphernalia. In the illustration one sees a nickel-plated stand large enough to contain a deck of cards. An ordinary deck of cards is freely passed for examination, and then placed in the houlette. At command, any number of cards will rise in rotation, or if desired the entire deck will leave the houlette one at a time in a most mysterious manner.





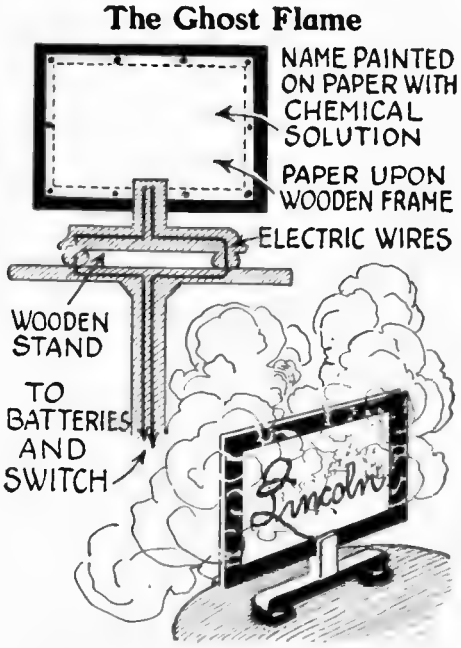

The diagram will disclose the fact that a rubber roller to which a small spool has been attached, is mounted within the houlette. The spool itself has been previously wound with a thin black silk thread and it is this thread which is chiefly responsible for the weird effect. As the roller revolves when the thread is pulled, the card pressed to its edge is first caused to rise due to the friction exercised by the roller upon the back of the card. The entire deck is constantly pressed against the roller by means of a double spring arrangement across which springs a cross bar is attached. The springs maintain a constant friction against the roller and for this reason the entire deck may be made to leave the houlette one at a time. The rapidity of their departure from the holder may be increased or decreased by pulling the thread more rapidly or slowly.

## A Mystic Smoke




This trick may be easily performed. An ordinary cigar box is constructed as illustrated in the above diagram. The male members in the audience first select a few cigars. The performer then starts to return to the stage but remembers that there are also ladies in the audience. In turning over the cigar box and opening the same the doves in the lower compartment fly out.

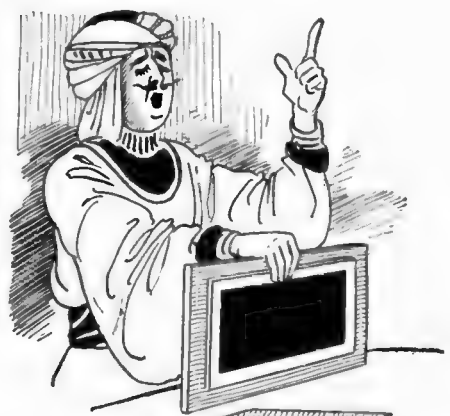
## The Ghost Flame

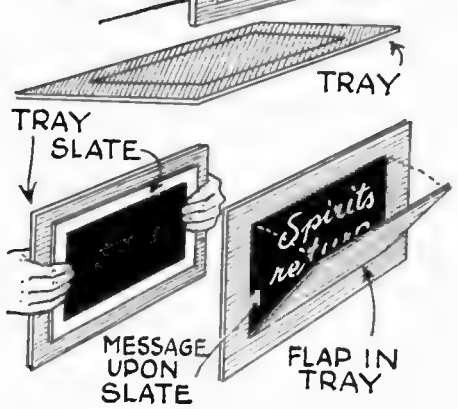



Some member in the audience is requested to mention the name of one of the great men in history. The name selected mysteriously appears in the form of a small traveling flame. A small piece of fuse wire connected across the cables leading to the batteries ignites the mixture with which the sheets have been prepared. The name is written with a solution of six parts of potassium nitrate and one half part of gum-Arabic dissolved in four tablespoons full of water.

## A Spirit Slate

Perhaps one of the most impressive forms of mystification are those wherein the apparent unknown psychical powers are brought into play. In the particular device here described a new principle is employed which the writer feels will meet with approval by those who desire to perform this trick before an audience. An unprepared slate is passed for examination. A member of the audience is then requested to write a series of sentences or questions upon the slate. This is then placed upon a tray with the writing facing the tray so that the performer could not possibly have obtained a






glimpse of the questions written upon the slate. The performer then holds both the slate and the tray in an upright position and walks back upon the stage. He may then go into a seeming trance, during which he will answer the questions written upon the slate. In this effect, as in many others, "all things are not what they seem." Of course the writing cannot be perceived while it is held on the slate in a horizontal position, but the instant both slate and tray are raised to a vertical position, the performer may secretly let down the flap in the tray which will reveal to him all the writing upon the slate. With but little practice it will be found that the flap can be opened or closed quite unnoticed. If the tray is covered with a figured cloth, either velvet or needlepoint material, the flap will never be noticed. The tray is never passed for examination.

# The Modern Housewife's Knowledge of Mechanics

By MRS. CHRISTINE FREDERICK

I AM frank to say that I believe a very serious cross-roads lies in the path of American women. Shall, or shall they not become imbued with the mechanical spirit of the times? Will, or will they not consent to mechanize their homes to a greater degree? Can, or can they not become a little more handy with mechanics?

The answer to these questions depends upon whether women will master their serious home and servant problem, or whether we must expect that the home remain 100 years behind factory and office.

The serious situation is that women, following a sort of man-fostered tradition, have entirely neglected any knowledge or interest in mechanics. Dolls for girls, engines for boys, you know. The result has been a *complete failure in preparing women for a mechanical civilization.* Women have resisted, as a consequence, the adoption of mechanical equipment in the home, until within recent years. An egg-beater was their greatest concession to the principle of the wheel and the lever, which are of such stupendous importance to the world. The washing machine lagged behind unbelievably, until war times; millions of homes are without one even today. I have a battery of two of them, worked by electricity, each with its wringer; I have also an ironing machine—and yet an average of two out of three servants I hire *actually prefer to use the washboard!* They don't like "mechanical contraptions." What's more, they ruin them, even if they try to use them, because they know less than does an 8-year-old boy about mechanics.

This situation with servants is the despair of the well-to-do who can afford mechanical devices. Many a kitchen queen of today flatly refuses to learn anything new, or to operate any new-fangled device. Either she does as she likes or she "gives notice." She resents the mistress' very presence in her kitchen. The average housewife gives up in despair, and lets her do as she likes.

But after all, there are less than one million families who have servants. Eight million other comfortably situated housewives do a great part of their housework. They are the important ones to think about. They can afford a moderate investment in mechanical household equipment; but the situation with them is complicated by several factors. First, to persuade them that they should buy it, and, second, to teach them how to use it and how to care for it after they buy it. An astonishing amount of mechanical home equipment is junked after the novelty wears off, or after the housewife has a little trouble with it (often merely because she can't set it up, or doesn't oil or clean it). It is true that a lot of home mechanical equipment is manufactured unpractically—failing to make it simple enough or fool-proof for average home use. Often it is manufactured with the false idea that women are mechanics and can operate it easily; even the instructions for operation are often ridiculously technical.

But that's aside from my point here, for a mechanism is after all a mechanism, and women simply must learn more about it if they are to enjoy its benefits. What often happens is that some slight thing occurs, perhaps merely a screw loose, or some little error in setting up, and then they send for an electrician or mechanic, who comes, gives one turn of his wrist, and hands in a bill for $5.00. The housewife is thus embittered; and sometimes she doesn't send for a mechanic at all, but just lays the device away, saying "it doesn't work," and vowing never again to invest in a mechanical contrivance.

In other days friend husband was more of a handy man and did more "fixing"; but nowadays he's not around so many hours, and often is himself quite ignorant of mechanics (this being a "white collar" age). You would think the automobile would make men into mechanics, but with a garage at every corner, and the marvelous development of automobiles, great numbers of men owning cars never touch its mechanism. So not all housewives get much help from the men of the families.

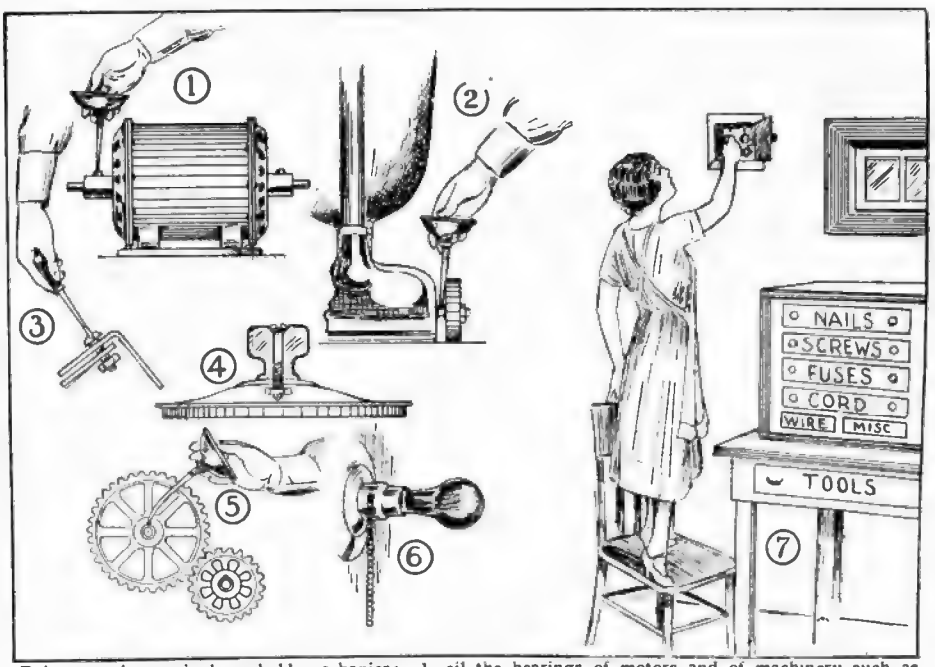
A modern housewife needs to know practical mechanics and electricity—not as an unpleasant thing to study, but as a housekeeping pleasure. A good amateur electrician-mechanic-housewife is far more independent, economical and calm-tempered, because she is *really mistress* of her house; not a babe lost in a maze of mechanisms and at the mercy of indifferent, high-priced mechanics. She can also intelligently check the bills of people who do odd jobs and repairs; and she can carry out little ideas of her own which embellish the home. Also she can meet emergencies without hysterics.

Best of all, she reaps to the full the reward in leisure time, by using the modern labor-saving mechanisms. She can feel that exhilaration, that mastery of work which men feel when they apply electricity and machinery to their tasks; and use the time gained in wider interest and culture.

I will never forget the bulging eyes and startled look of a cook I once hired who complained of the work schedule I gave her, which called for a half day of baking on Friday. She had always had to have a *whole* day, she expostulated. Smilingly, I told her that I could do in two hours what I had scheduled her for half a day. She was scornful, so I did it! I used the fireless cooker, the steam pressure cooker, the electric mixer, etc., after scheduling the different operations in rotation; and as she watched me prepare and later pull the pies, the cakes, the bread, the cookies, etc., out of the oven in quick succession, she gasped; and I am sure thought I was a sort of Keller the Magician, pulling rabbits out of silk hats!

I knew how to use the modern kitchen mechanisms—that was the only reason for I knew how to deftly get the mechanical devices to do my bidding.

I keep, for my own personal use, a metal case with a handle, filled with trays with compartments for different sized screws, nails, tools, etc., which is my work box, my tool kit. I don't wait for my husband, or the plumber or electrician when some minor thing goes wrong. I was no different from other women as a girl in my avoidance of mechanics; but I have realized what many women refuse to realize, that this is a decidedly mechanical age, and that it is an uncomfortable world for any woman who refuses to learn anything about mechanics.




Points to observe in household mechanics: 1, oil the bearings of motors and of machinery such as washing machines; 2, oil rollers of vacuum cleaners; 3, use small stove bolts for repairs, using them also for holding on knobs as in 4; 5, oil gear bearings of all kinds; 6, turn off current before repairing sockets; 7, use one hand only in replacing fuses, so as to avoid shocks; stand on chair or piece of dry wood, paper, etc., to avoid shocks also.

Of course, I know what some women reply to this. They say to other women, with a certain superficial cynicism: "Never learn mechanics, or men will expect you to fix things. If you plead ignorance, some man will always do it for you." This is very cheap philosophy that belongs to the parasitic age of women. Women are too independent today for such ideas, which are closely related to those of the age when women fainted at the slightest excuse as a demonstration of their appealing weakness.

A housewife of today is operating too many mechanisms to be ignorant of mechanics. She penalizes herself too much by such ignorance, which is a black mark on her intelligence. Tatting, knitting, crochet work and other ridiculous old-time training of women's hands is as much out of place as is the spinning wheel. Instead, women of leadership should set the fashion anew for modern women, and see that high schools teach manual training, physics and electricity to women.

In our illustration above, we show some details of mechanics that will be of great assistance to the housewife. One thing to be remembered is that system should be followed in all branches of this work. For instance, an excellent arrangement for keeping small parts is shown at 7 in the drawing. If a small chest of this type is placed in a convenient corner, you will never have to look around for an odd sized nail or an extra fuse. They will always be where you want them and in their right places.

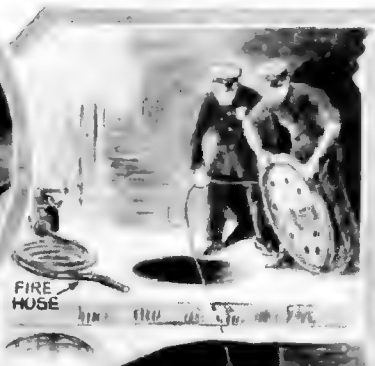
# The Month's Science News Illustrated

The News of the World Told in Picture Form

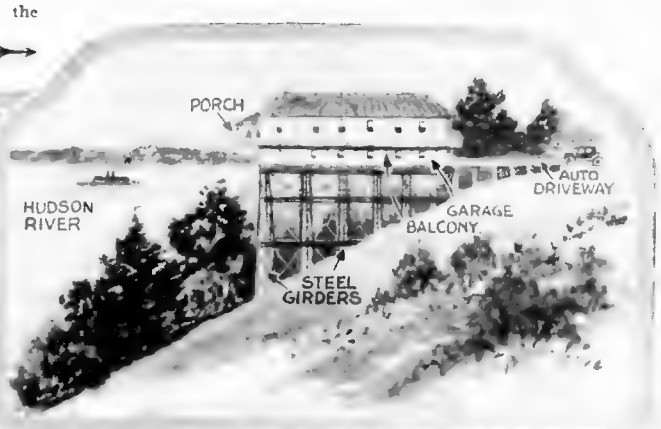
By GEORGE WALL

New York's queerest house is built up in the air overlooking the Hudson River.

Recently a cloud of flying ants invaded a French town and attracted by the street lights, they swarmed around them plunging the town into almost complete darkness. Their numbers were so great that when they clustered around the street light globes, they cut off the illumination from that source.



In Passaic, New Jersey, a veteran of the World War, out of work and half crazed, hid for days in the city sewer system. Grappling hooks and fire hose could not oust him but he was finally driven out when tear gas bombs were employed.

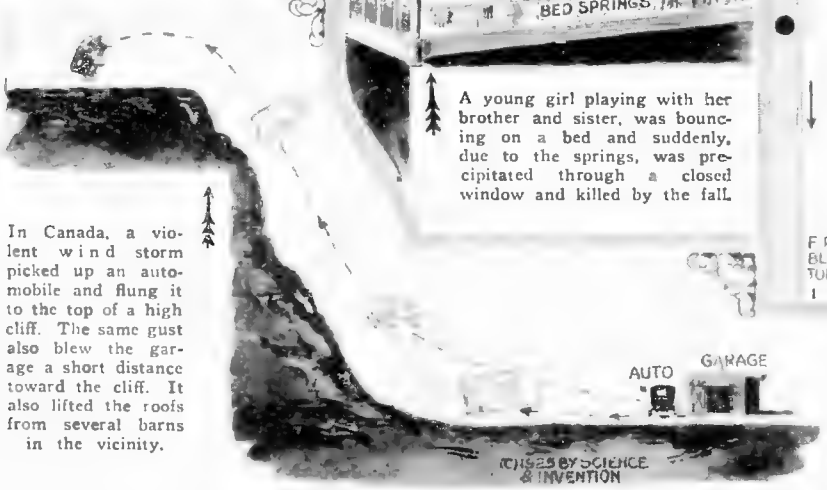



High up over Riverside Drive in New York City towers a most unusual private home. Built on steel girders, its highest part is 120 feet above the ground. Balconies are built around three sides of the house and from them observers can see far down the river to the bay and northward for many miles.

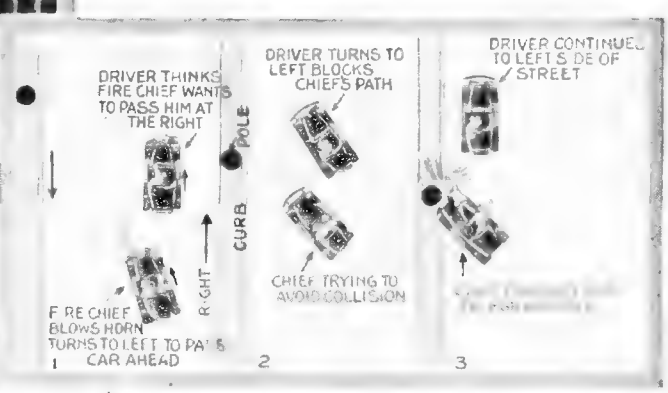
At an Eastern horse race track, it was recently discovered that some of the horses had been doped. This was accomplished by administering carbon monoxide gas as shown above.

In a novel shooting gallery in France, every time the bull's-eye of a target is hit, a pretty young lady clad in thin lingerie falls out of bed on a small stage placed to one side of the target. The mechanism that does this is similar to that shown directly above.

A young girl playing with her brother and sister, was bouncing on a bed and suddenly, due to the springs, was precipitated through a closed window and killed by the fall.




In Canada, a violent wind storm picked up an automobile and flung it to the top of a high cliff. The same gust also blew the garage a short distance toward the cliff. It also lifted the roofs from several barns in the vicinity.

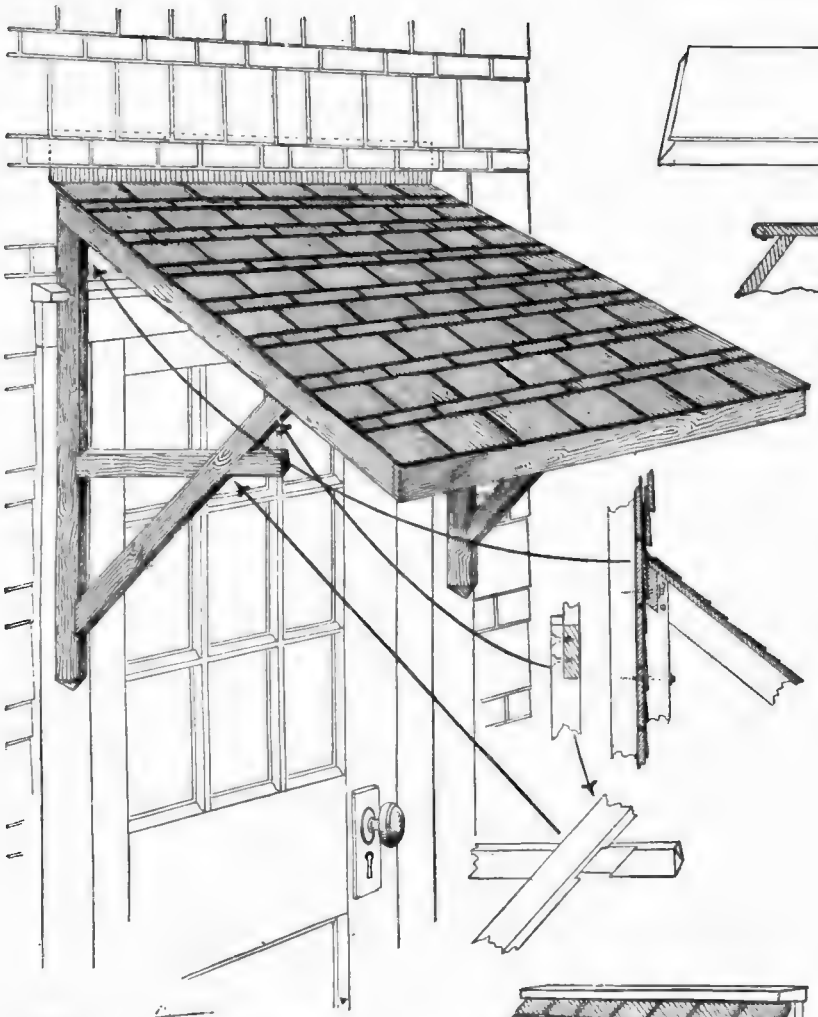

DRIVER THINKS FIRE CHIEF WANTS TO PASS HIM AT THE RIGHT
POLE
CURB
RIGHT
DRIVER TURNS TO LEFT BLOCKS CHIEF'S PATH
DRIVER CONTINUES TO LEFT SIDE OF STREET
FIRE CHIEF BLOWS HORN TURNS TO LEFT TO PASS CAR AHEAD
CHIEF TRYING TO AVOID COLLISION
1
2
3

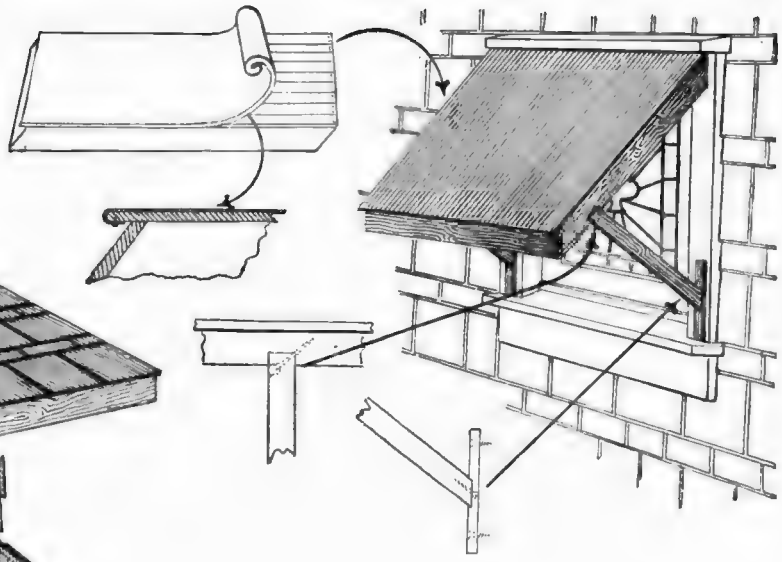
A misunderstanding in traffic recently caused the death of a New York Fire Chief. Traveling up a street at a high rate of speed, as in Fig. 1 above, the chief sounded his horn to warn a driver ahead. Through a misunderstanding, the other driver swerved to the left instead of the right, and in trying to avoid him, the chief's car crashed into a telegraph pole and the chief was killed.

# Protections for Windows and Entrances

## Beautifying the Home in a Simple and Practical Way

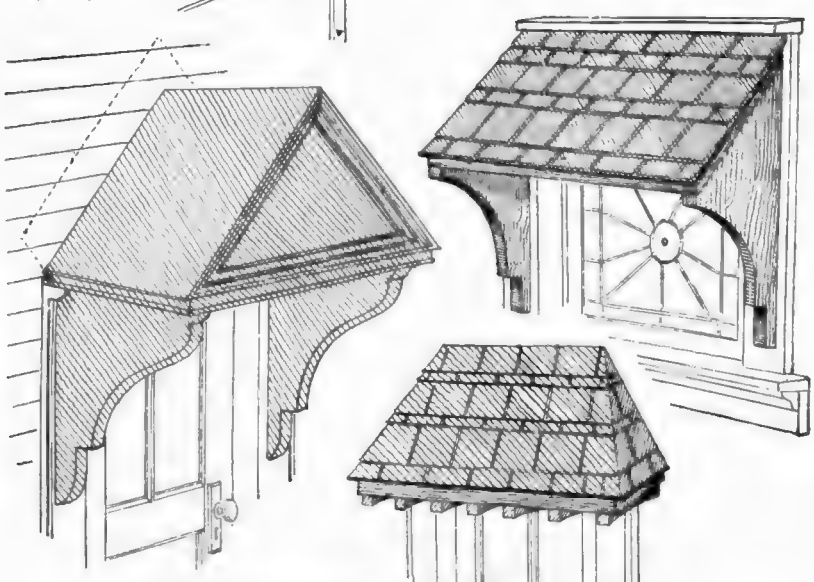
By WILLIAM M. BUTTERFIELD

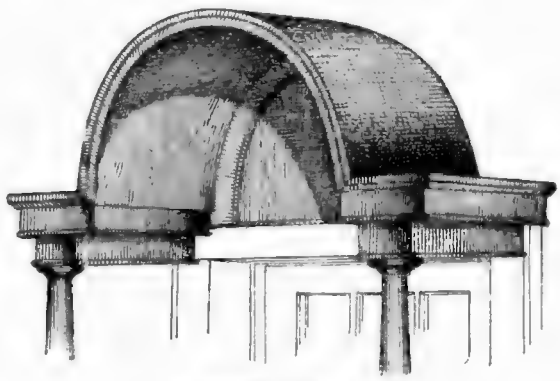


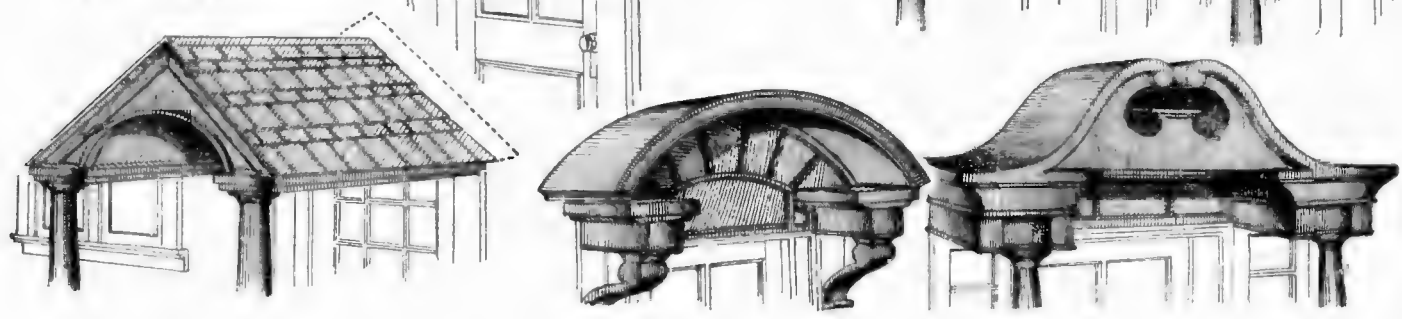


IT often happens, that some door or window in a new house is not sufficiently protected from the elements or from direct sunlight. In such an event, the home mechanic can, by exercising a little ingenuity and by carefully studying the drawings on this page, construct an artistic covering for one or more of these places. A roof over a side porch will protect a person while searching for the key or if constructed over a window will keep out the direct and blinding rays of the sun. The two drawings at the top of this page show how coverings of both of these types can be constructed and the small detailed drawings give all the information necessary. The tops of these small protections can be covered with canvas, shingles, copper or tin. The entire assembly can then be stained or painted any desired color.

If the builder desires to go in for more elaborate construction, those drawings given to the left and below can be followed. Although they may appear difficult to carry out, still they are actual examples of home workmanship. Standard molding, trim and veneered sheets were utilized and were sawed into the various shapes or bent and nailed to inclosed rafter supports. The designs shown have all been constructed with the original door frames which they cover.







# Tarrano the Conqueror

EIGHTH INSTALLMENT

By RAY CUMMINGS

*First American and Canadian Serial Rights*

For a moment Argo stood swaying. Eyes white-rimmed with mortal terror as he stupidly looked down at the drop of blood. A moment, then the injected poison took effect. He tottered, flung his arms above his head and fell.

*SYNOPSIS*

*IN the spring of the year 2325, all of the rulers of the various countries of the earth are mysteriously murdered. Jac and Grayson, employees of a large news organization, find that the murders are the result of a plot on the part of the inhabitants of Venus. Tarrano, an erstwhile lower official of the Cold Country of Venus is found to be at the head of a plot to rule the universe.*

*Dr. Brende, a friend of Jac's has discovered a medical method whereby human beings may be kept from growing old. The Doctor is killed by a group of "Venus-Men" and Jac, Elza, the Doctor's daughter and Georg, the Doctor's son, are captured and taken to Venia, a city on the earth inhabited by people of Venus. Here they are imprisoned and Wolfgar, a Venus-man, friendly to the people of the earth, surrounds them by an electrical isolation barrage in an attempt to rescue them. The barrage is broken down and in the resulting confusion, Georg escapes to Washington in company with Princess Maida of Venus.*

*The next day, Tarrano offers to return the papers and models of the invention made by Georg's father, which he has confiscated and brands young Brende as an impostor. To offset this accusation, Georg is to tell his story to the earth as well as to Venus and Mars by radio and helio. He and Princess Maida go to the station but there they disappear.*

*Jac, Wolfgar and Elza, still captives, are removed from their prison and taken to the top of an enormous tower. Here, in the instrument room, where communication with the various planets is held, they view the disappearance of the Princess Maida and Georg by television. The abduction has been done by Tarrano's agents. On Mars, Tarrano's followers are attacking the ruling class and Tarrano offers Dr. Brende's secret to the public if they will surrender to his cohorts. They agree. Tarrano then announces to the earth people, that he will not give them the Brende secret and declares war upon them, challenging them to attempt to conquer him.*

*The air war vessels of the earth government start to attack Venia, but Tarrano sends up a bomb of surrender and then, with Elza, Jac and Wolfgar, he escapes through an underground passageway to a space-flyer. They go on board and are taken to Venus to where Georg and the Princess Maida have previously been transported. They are royally welcomed and go to the palace of the Princess Maida. Here they are attacked by Argo, one of Tarrano's men, who shoots a violet-colored beam of light across the room, separating Maida from the rest of the party. He threatens to kill her, when suddenly Wolfgar throws himself into and through the violet beam of death.*

## CHAPTER XVIII

### THE PASSING OF A FRIEND

WOLFGAR was not dead; but when we picked him up it was obvious that he was dying. The violet beam vanished as his body struck it—vanished with a hiss and splutter, and a puff of sulphuric smoke that mingled with the smell of burning garments and flesh.

Georg and I leaped forward. Argo was standing transfixed by surprise at what Wolfgar had done; and as the beam died, Georg was upon him.

"One moment!"

The quiet, commanding voice of Tarrano. He must have come quickly, when informed by the finders of Argo's treachery. Yet he stood now at the arcade entrance, drawn to his full height, frowning with lowered brows, but wholly without appearance of haste.

"One moment—stand aside, all of you."

Argo cowered. The rest of us moved aside. Elza came toward me, and I put my arm around her. Poor little Elza! She was shivering with fright.

Tarrano seemed not to need information as to what had transpired. His eyes, roving over us, saw the lifeless, seared body of Wolfgar lying on the floor.

"Too bad," he said. Then his gaze swung to Argo. The wretch cringed.

"Master——"

"Silence!"

There was on Tarrano's face and in his voice an expression, a tone quite new to me. A quiet grimness. More than that. A quality of deadliness—of inexorable deadliness which could well have chilled the stoutest heart that fronted it.

"Come here, Argo." Tarrano stood quite motionless. "Argo!"

"Master! Master, you——"

"Come!"

Argo was on the floor. Shaking with terror—for he, probably better than any of us, understood what was coming—dragged himself to Tarrano's feet.

"Stand up!"

"Master, have mercy——"

"Stand up! Are you a man?"

Argo's legs would barely support him, but he struggled to get himself erect. With a wrench, Tarrano tore the robe from Argo's chest.

"Master! Master! Have mercy!"

In Tarrano's hand I saw a needle-like piece of steel. A dagger, yet it was more like a needle.

"Master—Oh——"

Tarrano had stabbed it gently into the man's chest. A mere prick into the flesh, and a tiny drop of blood oozed out.

For a moment Argo stood swaying. Eyes white-rimmed with mortal terror as he stupidly looked down at the drop of blood. A moment, then the injected poison took effect. He tottered, flung his arms above his head and fell. Lay writhing an instant; then twitching; and then quite still.

Tarrano turned away, his face impassive. "Unfortunate. He was a good man in many ways—I shall be sorry to lose his services." He saw me with my arm around Elza, and he frowned.

"So?"

Instinctively, involuntarily—and I hated myself for it—I dropped my arm.

Georg exclaimed: "Wolfgar—he——"

Tarrano turned from me. "He is not dead—but he will die. There is nothing we can do. I'm very sorry—very sorry indeed."

A sincere regret was in his tone. We lifted Wolfgar up, carried him to a depression in the floor by the wall—a shallow, couch-like bowl half-filled with down.

On the floor we gathered, seated on cushions; and presently Wolfgar regained consciousness. His face was not burned. It lighted with a dazed smile; and his eyes, searching us, picked out Maida.

"You are safe—I'm—so glad."

His voice was low and labored; and at once his eyes closed again as though the effort of speaking were too great.

Maida was sitting near me at Wolfgar's head, bending over him. She had recovered from her terror of Argo; and as she leaned down, gazing at the dying Wolfgar, I think I have never seen so gentle, so compassionate an expression upon the face of any woman.

Elza whispered: "There must be something we can do. The men of medicine—the lights—the healing lights! Georg! Cannot you use your father's——"

They were only an overwrought girl's ex-

The aural lights mounted the sky. The holiday spirit which was on Tarrano was spreading everywhere throughout the city.

cited ideas, of course. Wolfgar's lungs were seared; even as Elza spoke, he coughed, and blood welled from his mouth—blood which Georg quickly wiped away.

Tarrano was on his feet behind us, with folded arms; and as he looked down, I saw on his face also—the face which a few moments before had been grim with deadly menace—a look now of gentle compassion very much like Maida's.

"No use," he said softly. "We can do nothing. He will die."

Again Wolfgar's eyes opened. "Die—of course." He tried to raise one of his burned hands, but dropped it back. "Die? Yes—of course. In just a moment . . ." His eyes, already dulled, swung about. "Who is that—crying? There's no need—to cry."

It was little Elza beside me, struggling to suppress her sobs.

Wolfgar's slow, labored voice demanded: "That isn't—my Princess Maida crying—is it?" I don't want—her to cry——"

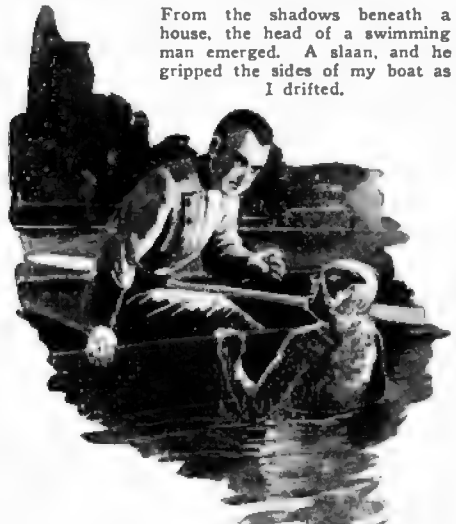
"No," said Georg gently. "Maida is here—right here by you. She isn't crying."

His gaze found Maida's face. "Oh, yes—I can see you—Princess Maida. You're not crying—that's good. There's nothing to—cry about."

He seemed for a moment to gather a little strength; he moved his head and saw Tarrano standing there behind us.

"Master?" He used the old term with a whimsical smile. "I—called you that—for a long time, didn't I? You have a right to consider me a traitor——"

"A spy," said Tarrano very gently. "Not a traitor. That you would have been had



From the shadows beneath a house, the head of a swimming man emerged. A slaan, and he gripped the sides of my boat as I drifted.

you served me—a traitor to your Princess."

Wolfgar's head tried to nod; relief was on his face. "I'm—glad you understand. I would not want to die—having you think harshly of me——"

"You are a man—I honor you." Abruptly Tarrano turned away and strode across the room. And always since I have wondered if he left that scene of death because of the emotion he could not hide and which it was not his nature to admit.

Georg said: "You should not talk, Wolfgar."

"But I—want to talk. I have—only a few minutes. Just these—last few minutes—I want to talk to my—Princess Maida. You'll—excuse us—the Princess Maida and me—won't you? Just for these last—few minutes?"

We withdrew beyond his fading sight.

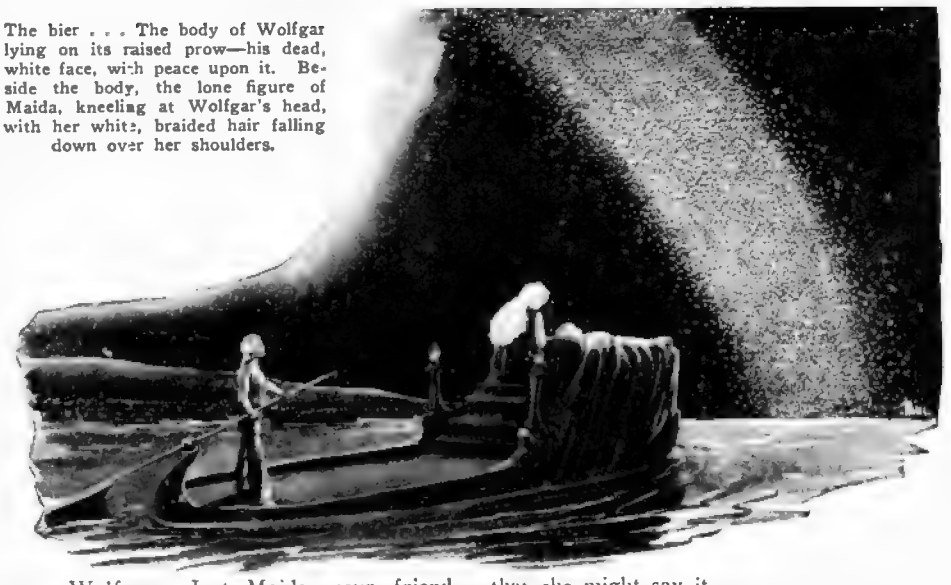
"My—Princess Maida——"

His voice still reached us. She leaned closer over him. Her tears were falling now, but as she spoke she strove for calmness.

"Wolfgar——"

His eyes were glazing, but they clung to her. "Princess——"

"No," she said. "Not only you Princess



The bier . . . The body of Wolfgar lying on its raised prow—his dead, white face, with peace upon it. Beside the body, the lone figure of Maida, kneeling at Wolfgar's head, with her white, braided hair falling down over her shoulders.

now, Wolfgar. Just Maida—your friend. The woman you have given your life for." Her voice almost broke. "Oh, Wolfgar! Never shall I forget that. To give your life——"

"It is—a great honor." The gesture he made to check her words of thanks exhausted him. His eyes closed; for a moment he seemed not to breathe. As Maida leaned down in alarm, her beautiful white hair tumbled forward over her shoulders. A lock of it brushed Wolfgar. He could not lift his hands, but they groped for the tresses, found them and clung. Her white waves of hair, with his fingers, shriveled, burned black, entwined in them.

Again his eyelids came up. "You won't leave me—Princess Maida. Not for these—last few minutes?"

"No," she half whispered.

"You—cannot—if you would." His whimsical smile returned. "You see? I am—holding you."

For a moment he was silent. His eyes stayed open, staring dully at her. His face and lips were drained now of their blood.

"You're—still there?"

"Yes, Wolfgar."

"Yes—of course I know you are. But I—cannot see you very well—now. You look—so far away."

She put her face down quite close to him. Her eyes were brimming with tears.

"Oh—yes," he said. "That's better—much better. Now I can—see you—very plainly. I was thinking—I wanted to—tell you something. It—wouldn't be right to tell you—except that I'll soon—be gone where it won't make any difference."

He gathered all his last remaining strength. "I—love you—Princess Maida."

She forced a gentle smile through her tears. "Yes, Wolfgar."

"I mean," he persisted, "not as my Princess—just as—a woman. The—woman I've always loved. That's been my secret. You see? It would—always have been—my secret—the little Mars-man Wolfgar—in love with his Princess Maida. You—don't think it too impertinent of me—do you? I mean—confessing it now—just at—the end?"

"No," she whispered. "No, Wolfgar."

"Thank you—very much." His breath exhaled with a faint sigh. "Thank you—very much. I wanted to tell you that—before I—go. And—if you wouldn't mind—I want to—call you—just Maida."

"Just Maida, Wolfgar. Yes, of course, I want you to call me that." Her voice was broken. She brushed away her tears that he might not notice them.

"Yes," he agreed. His staring eyes were trying to see her. "My Maida. You're—very beautiful—my Maida. I—wonder—you see, I'm taking advantage of you—I wonder if you'd say you—love me? I'd be so happy—just to hear you say it."

As I sat there behind them, I prayed then that she might say it.

"I love you, Wolfgar."

"Oh," he whispered. "You *did* say it! My Maida says that she loves me!" Happiness transfigured his livid face. But his smile was whimsical still. "You're—very kind to me. Please—say it again."

"I love you, Wolfgar."

"Yes—that's how I always dreamed it would sound. I—love—you—Wolfgar."

His voice trailed away; a film was settling over his staring eyes. Then again his lips moved. "Maida says—'I love you, Wolfgar' . . . . I'm—so happy . . . . so happy . . . ."

Quite suddenly she realized that he was gone. Her pent-up emotion came with a sob.

"Wolfgar! My friend—my wonderful, loyal friend—don't die, Wolfgar! Don't die!"

## CHAPTER XIX

### THE WATERS OF ETERNAL PEACE

Little Wolfgar was gone. It seemed at first very strange, unreal. It lay a shadow of grief upon our spirits, for many hours a deeper shadow than all those grave events impending upon which hung the fate of three worlds.

Tarrano ordered for Wolfgar a public burial of ceremony and honor in the waters of eternal peace—ordered it for that same evening. Once again Tarrano demonstrated the strangeness of his nature. His arrival to take possession of Venus had been made the occasion of a great festival. "The Water Festival," they called it, which was held only at times of universal public rejoicing. It was planned now to do honor to Tarrano—planned for this same evening. But he postponed it a night; tonight was for Wolfgar.

We were still captives in Tarrano's hands, as we had been on Earth in Venia. Yet here in the Great City of Venus a curious situation arose. Tarrano himself explained it to us that afternoon. An embarrassing situation for him, he termed it.

"Very embarrassing," he said, with eyes that smiled at us quizzically. "Just for your ears alone, you understand, I am willing to admit that I must handle these Great City people very carefully. You, Princess Maida—you are greatly beloved of your people."

"Yes," she said.

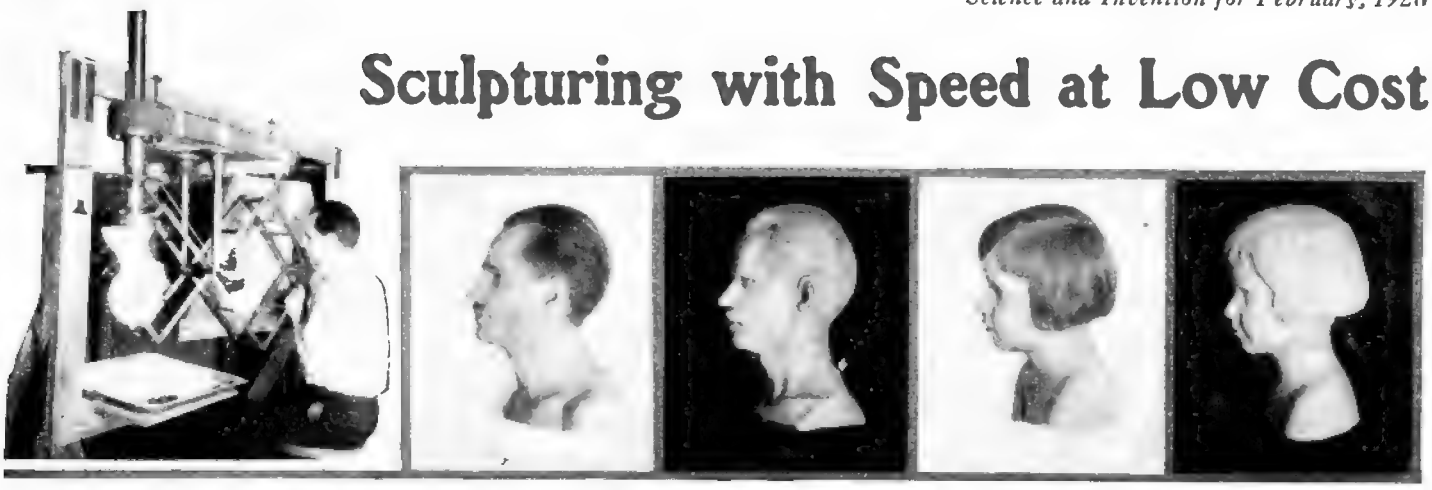
He nodded. "For that reason they would not like to know you are virtually a captive. And you, Georg Brende—really, they are beginning to look on you as a savior—to save them from disease and death. It is rather unflattering to me——"

He broke off, and then with sudden decision he added:

"Soon you two will realize that to join me will be your best course. And best for all the worlds, for it will bring to them all peace and health and happiness. . . . No, I ask no decision from you now. Nor from

(*Continued on page* 944)

# Sculpturing with Speed at Low Cost



The pantograph with its motor-driven cutters used in connection with this new high-speed sculpturing method is shown at the extreme left above. The other illustrations show original photographs and portrait sculptures made from these same photographs.

THE making of sculptured portrait busts has depended heretofore upon the trained eye and the skilled hand of the sculptor, and upon the willingness of the model to "sit" for tedious hours.

It is now possible to make the most faithful portrait busts in hard material almost as easily as it is to make a photograph on paper.

This is executed by a new sculpturing method, which has been invented and put into practical use by W. F. Engelmann of Chicago.

For making a form and feature record of a human head for instance, a strong and sharply outlined shadow is moved over the head. This moving shadow gradually reveals in its path the contour of the head in all its heights and hollows. During the time that these contours are revealed by the moving shadow a series of photographs are made of the head with a moving picture camera. The outline of each picture gives the exact contour that was indicated by the moving shadow on the head at the time of the photographic exposure. The outlines of all pictures combined give a perfect record of the form and features of the head, the sizes of the various organs, their relative positions in the face, the shape of the skull, and so forth.

For carving out the reproduction rotating cutters are used that are driven at a high speed by electric motors. Each picture of the photographic record is projected on a screen, and enlarged to any required size, and its outline is used as a pattern for carving out a corresponding contour on the reproduction. For transferring the contour of the picture to the material block, of which the head is to be made, a pantograph is used. Thus the many pictures are used in succession for carving out the complete head.

After the head is carved out with the cutting device, it shows very small cutting grooves which were left by the cutter. To smooth out these surfaces and to idealize the head and to give it the necessary artistic touch it is given to the sculptor.

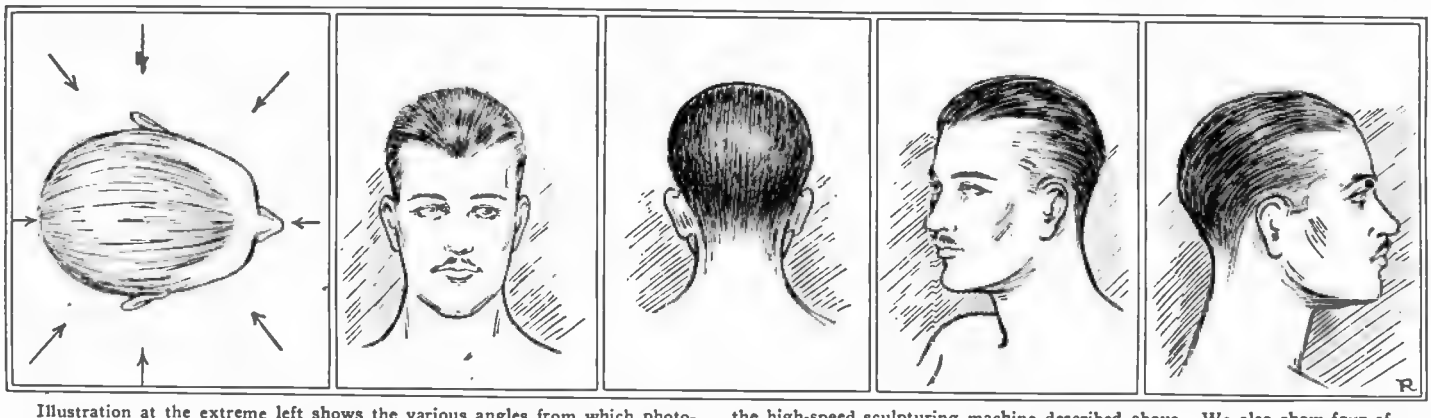


Illustration at the extreme left shows the various angles from which photographs are taken preparatory to using the finished series in connection with the high-speed sculpturing machine described above. We also show four of the many photographic views that are taken.

# $5,000.00 Prize "Matchcraft" Contest

WATCH FOR PRIZES IN MARCH ISSUE

FOR the next twelve months, SCIENCE AND INVENTION magazine will award a total of $5,000 in prizes, in a new contest. You are asked to make models, fashioning the same entirely from safety matches. Please read the text of the Matchcraft article carefully and observe the following simple rules:

(1) Models submitted must contain at least 90 per cent. safety matches in their construction.

(2) Models made of toothpicks, paper matches, or non-safety matches, are not eligible in this contest.

(3) Models can not be built around boxes or other supporting articles. Walls, roofs, etc., must all be self-supporting and made of matches.

(4) All liquid adhesives, such as glue, shellac, cements, etc., are permissible.

(5) Models may be painted, gilded or silvered.

(6) Models may be of any size.

(7) In order to win a prize, it is necessary that either models be submitted, or, if this is not practical, owing to their size, a photograph (large-sized) of the model may be sent in lieu of the model itself. The best models submitted each month will be awarded the prizes scheduled herewith.

(8) All models submitted to SCIENCE AND INVENTION Magazine will be promptly returned to the builder, who will prepay all charges.

## 16 Monthly Prizes

| | |
|---|---|
| First Prize | $100.00 |
| Second Prize | 75.00 |
| Third Prize | 50.00 |
| Fourth Prize | 35.00 |
| Fifth Prize | 25.00 |
| Sixth Prize | 20.00 |
| Seventh Prize | 15.00 |
| Eighth Prize | 12.50 |
| 9th to 16th Prizes of $10.00 each | $80.00 |

(9) Where SCIENCE AND INVENTION has any doubts as to the model (where photos only are submitted) complying with all the regulations, the judges may, at their discretion, request that the actual model be sent in for inspection, paying transportation charges both ways.

(10) This is a monthly contest, lasting for twelve months, each monthly contest closing on the first of the month following date of issue. This contest for the month of February will close March 1, 1926, and prize winning announcements will be made in the May, 1926, issue. The March issue will contain December prize winning entries.

(11) Models must be shipped in a strong wooden box, never in a cardboard box, as SCIENCE AND INVENTION can not be held responsible for breakage in transit due to models having been improperly packed.

(12) When models are sent, be sure to affix tag, giving your name and address, to the model itself. In addition, put name and address on outside wrapper of package.

(13) When photographs are submitted, it is necessary that they be at least 5" x 7", not smaller, and that your name and address appear on the back of each photograph.

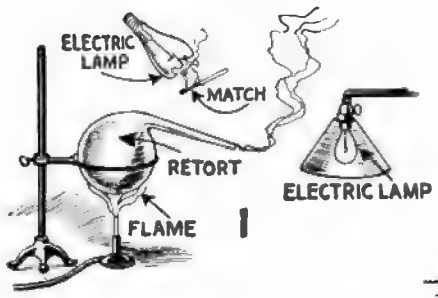
(14) In this contest, manuscripts or description of the models are not required, unless the model contains something unusual requiring explanation. Keep all descriptions short.

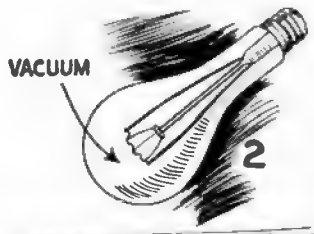
(15) Address all letters, packages, etc., to Editor, "Matchcraft" Contest, care SCIENCE AND INVENTION Magazine, 53 Park Place, New York.

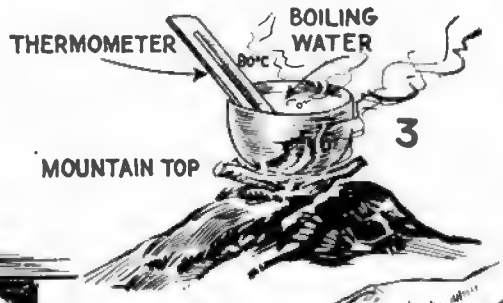
# Oddities of Science

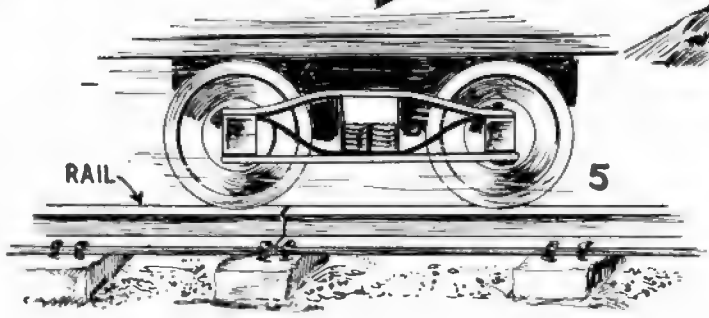
## Scientific Problems Described and Illustrated, Affording a Most Interesting Study

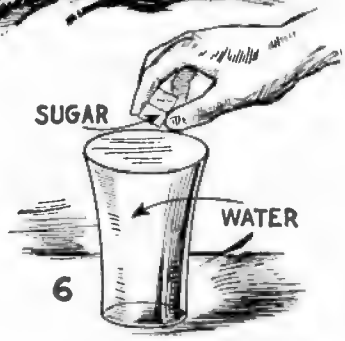
By RICARDO LUDEKE

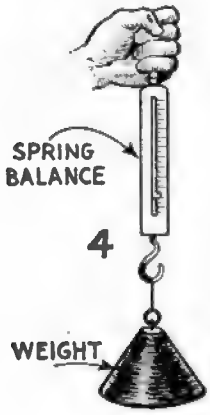


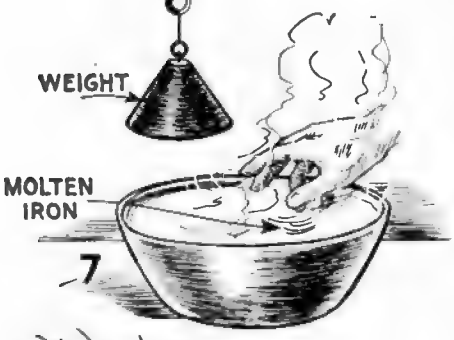



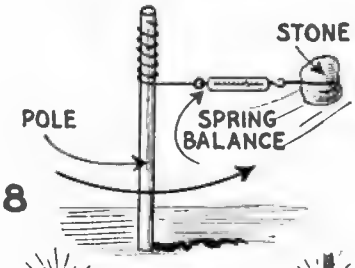



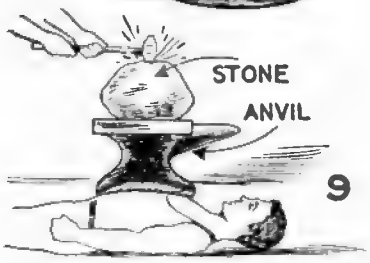



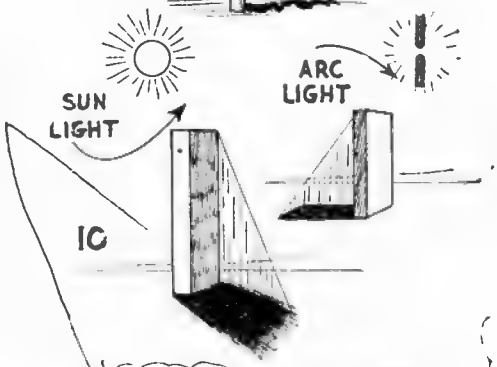



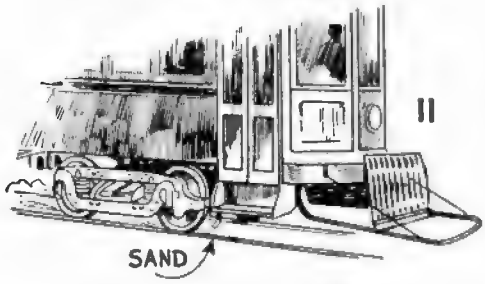



1. When glass is heated in only one spot or unevenly, it may break. Evenly heated, it withstands strains.

2. An electric light bulb is evacuated because if the filament were lighted in air, it would oxidize and burn out.

3. Water normally boils at 100° C. (212° F.), but when atmospheric pressure is decreased as at mountain top, boiling point lowers.

4. There is a difference in weights of objects at the poles and at the equator. One kilogram at the pole weighs 996.5 grams at the equator when measured with a spring balance.

5. A space is left between railroad rails to allow for expansion and contraction due to heat changes.

6. Sugar can be placed in a full glass of water without causing an overflow, because the sugar diffuses in the water when going into solution.

7. If the hand is wet, it can be put for an instant in molten iron, because the water vapor protects the skin.

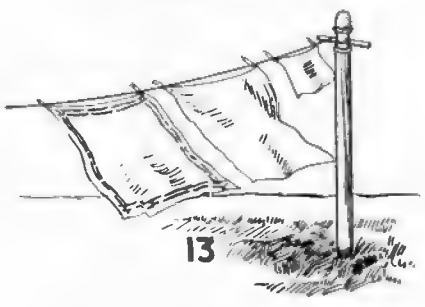
8. As the stone rotates, the spring balance will show greater pressure, because centrifugal force increases as the radius becomes shorter.

9. If a man can support an anvil on his chest, a stone can be broken on the anvil with no effect on the man, because of the inertia of the heavy anvil.

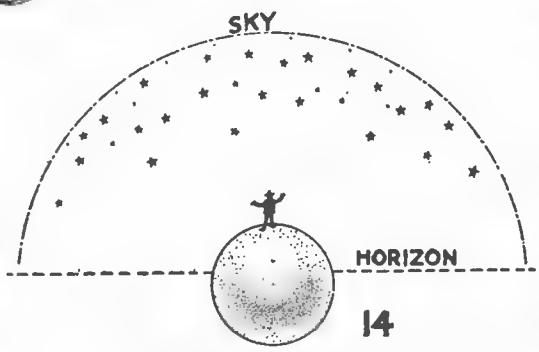
10. An arc light casts a sharp shadow whereas sunlight casts a diffused shadow. This is because of the fact that the first illumination is produced practically from a point and the second from a large body.

11. When sand is applied to the rails of an electrically driven train, sparks are formed and ozone can be smelled. The sand insulates the wheels from the rail forming sparks which in turn create ozone.

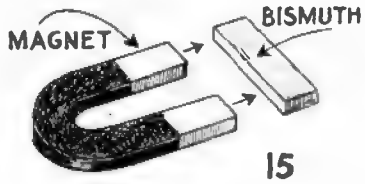
12. Due to the refraction of light entering water, the gunner must aim below the fish. This must always be taken into account when shooting at a mark under water.




13. Clothes are dried by the action of the wind carrying dry air and blowing away the vapor evaporated from the clothes. Drying is thus accelerated by a breeze.




14. Stars near the horizon are difficult to see because the atmosphere between the observer and the stars is thicker than toward the zenith and the light is absorbed.

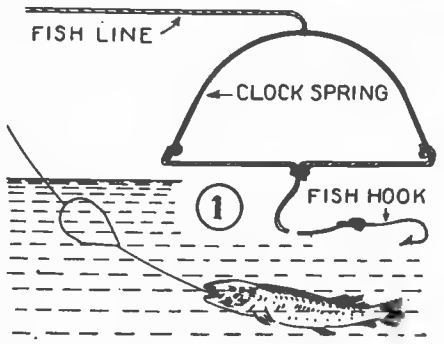


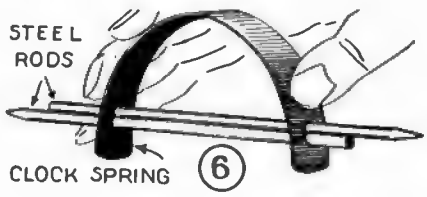

15. Bismuth is less permeable to magnetic lines of force than the air, whereupon it will form poles similar to those opposing it, and will be rejected from the magnet.

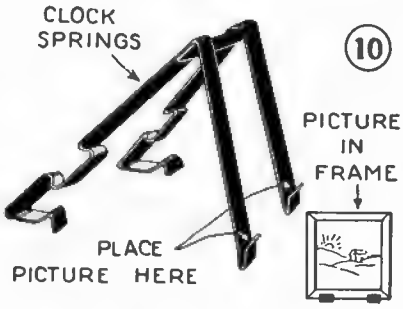
THESE COMBINATION PEN-PENCILS WERE THE PRIZES

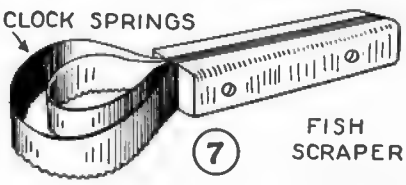
# Awards In the Big

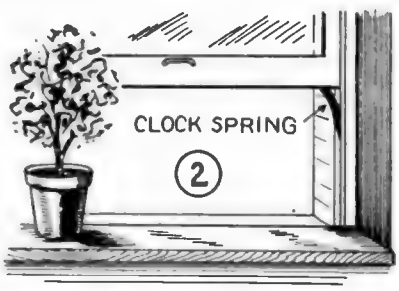
## Thousands of Entries Were Awarded to Those



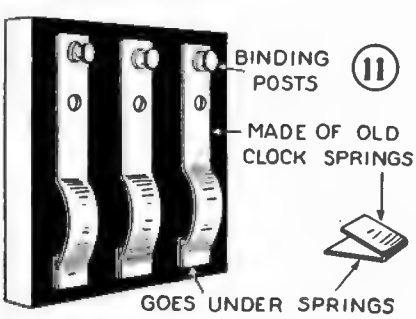



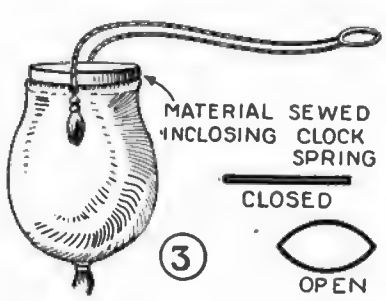



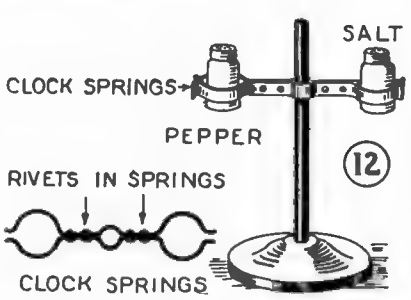



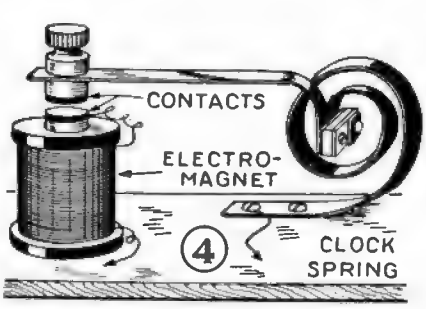



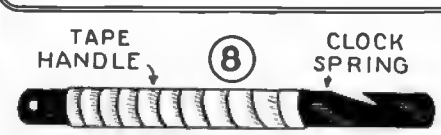

1, self-hooking fishing line. Spring serves to set the hook in the fish's mouth.—By Charles Ferrina. 2, window latch. Spring holds window open or can be pushed back into groove to allow it to close.—By Abe Tunis. 3, two strips of clock spring sewed in the mouth of a handbag. Press ends together to open.—By Mrs. J. Jacobi. 4, low voltage cut-out. This must be reset by hand before circuit can be used.—By J. Bront. 5, electric light bulb protector. Three strips one foot long are riveted as shown and provided with wire clips for fastening around base of lamp.—By Hugh J. Hamilton, Rep. 19,774. 6, inside calipers made of two steel rods and a strip of clock spring.—By Walter W. Wilhelm. 7, fish scraper.—By Ferdinand L. Holly. 8, stripper for removing insulation from wires.—By J. Harris. 9, hook for holding icebox cover in open position. Fasten clock spring catch to the wall.—By P. A. Judd. 10, picture stand. Very ornamental effects can be obtained by bending the clock springs.—By J. L. Sneed. 11, terminal jack. Use V-shape piece of clock spring for connections. Push under flat jack springs.—By Whitney Herries. 12, holder for salt and pepper shakers. The clamping ends should form a small enough circle to hold the shakers tightly.—By Jack L. Baker. 13, door stop.—By P. A. Judd. 14, cigar cutter. Sharpen angular cut edge of clock spring.—By Robert Davidson.

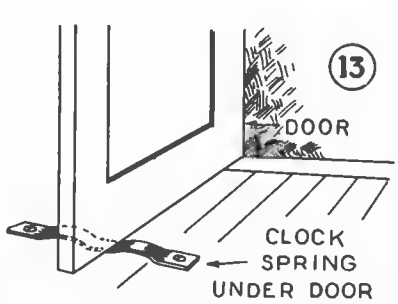


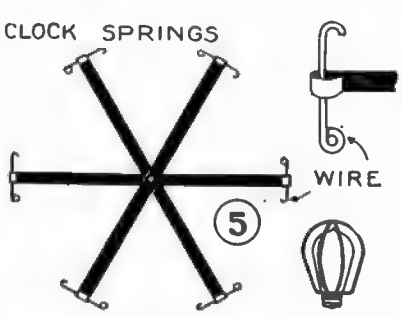



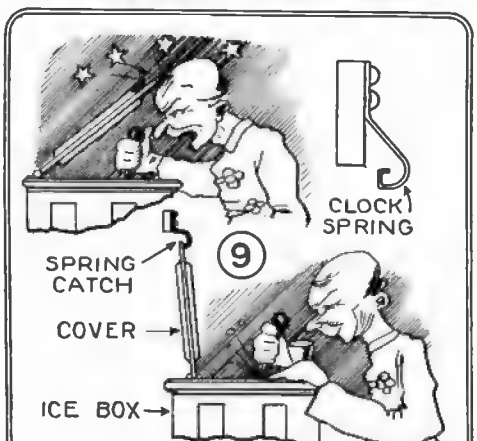



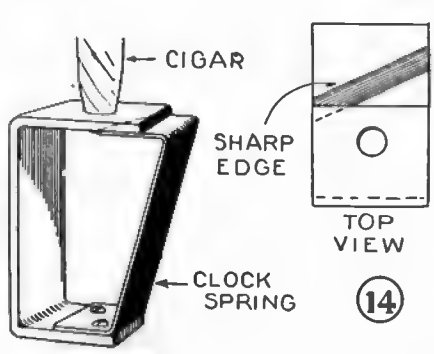



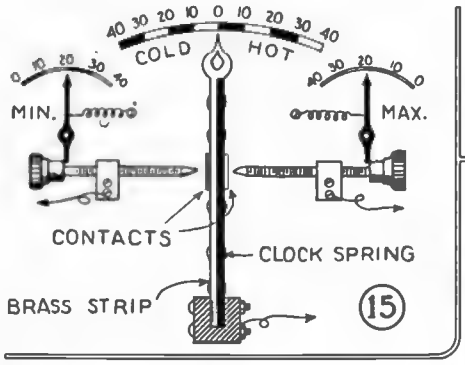



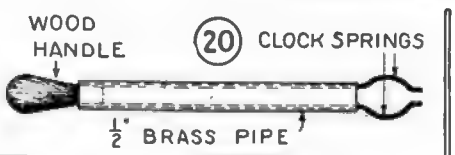



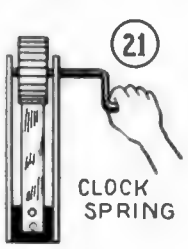
# Clock-Spring Contest

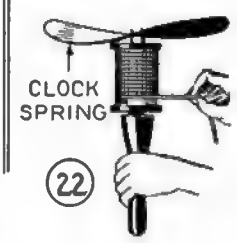
**Received and Prizes Were Illustrated Below.**

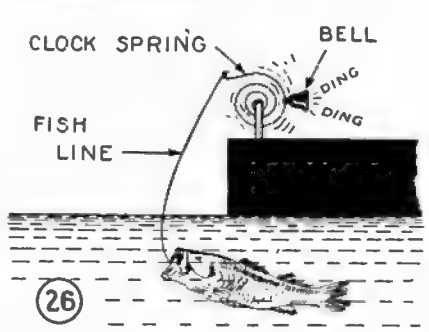
THIRTY OF THESE WERE AWARDED

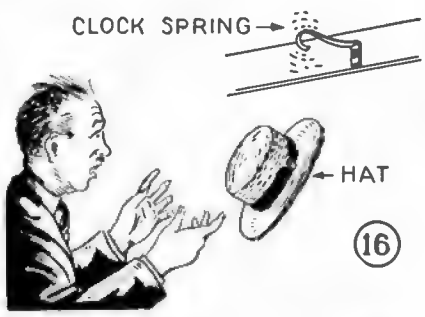


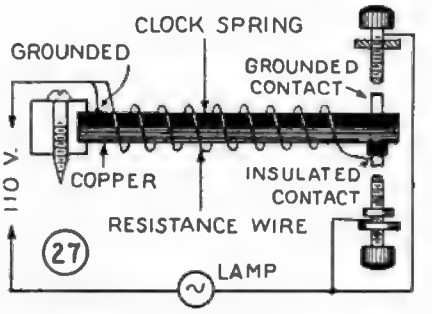



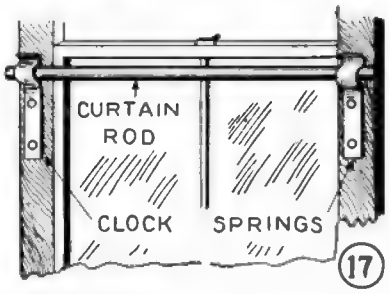



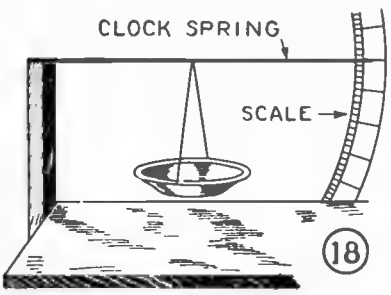



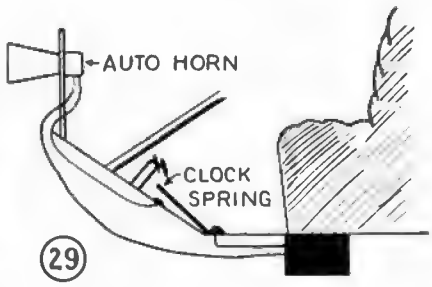



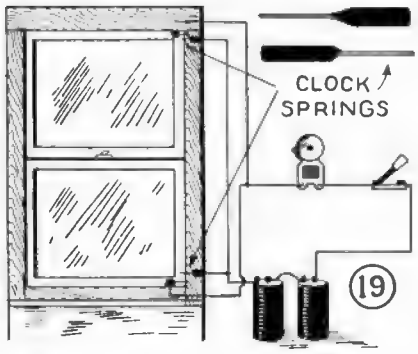

15, indicating and recording thermostat.—By J. Bront. 16, trick hat rack. Hat will not stay on it.—By Robert S. Edgerton, 17, holder for curtain rods that permits quick removal.—By J. Harris. 18, scale using clock spring. Adjust pan to desired position and calibrate curved scale.—By M. Stroh. 19, burglar alarm for windows that works regardless of which sash is opened.—By Richard Anderson (please send address). 20, device for starting nuts in tight places.—By J. Harris. 21, noise maker using clock spring.—(Author, please send address). 22, aerial toy. When string is pulled, propeller flies upward.—By Robert S. Edgerton. 23, fly swatter. Clock spring gives great flexibility.—By Arthur Skelley, Jr. 24, spring for distributor arm on automobile.—By R. H. Reynolds (please send address). 25, tack holder which leaves head of hammer free.—(Author, please send address). 26, signal bell for fishing where more than one line is used.—By Gerald Meyer. 27, lamp flasher. Light burns brightly and then dim. Place asbestos between thermostat element and resistance wire.—By Martin M. Held. 28, ash tray to clip to edge of table.—By Walter E. Kirchner. 29, foot control for automobile horn. Connect same as push button.—By Jack Silver (please send address). 30, mouse trap. Spring is held down by pivoted wooden latch which releases when the bait is pulled. Spring then tightens noose around the neck of the mouse, choking it to death.—By Ross J. Drew.

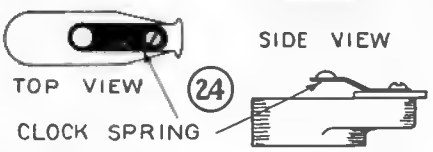


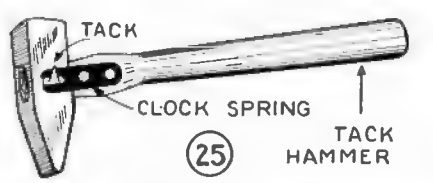



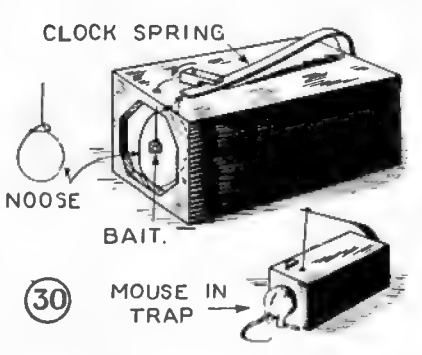




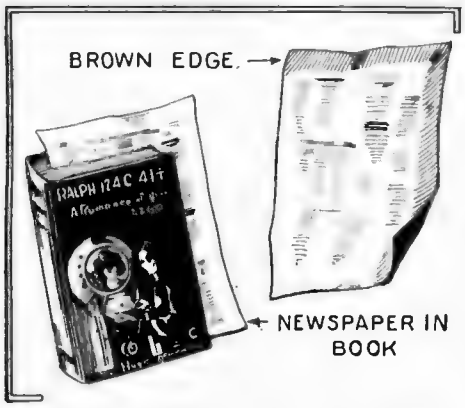



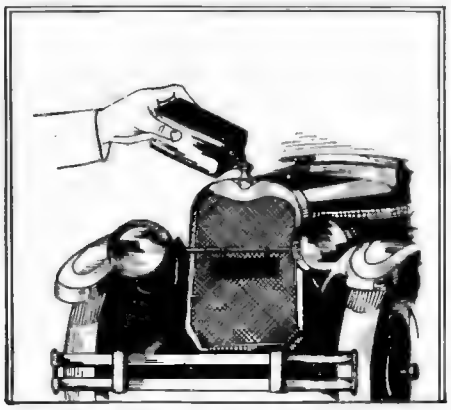



# Everyday Chemistry

By RAYMOND B. WAILES

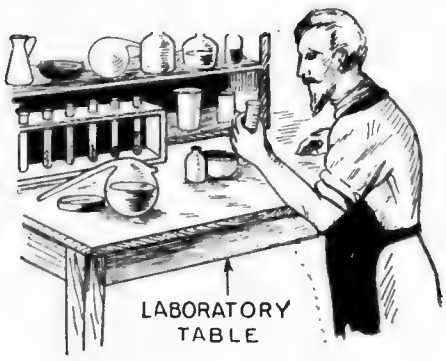



When paper is exposed to the air, the iron compounds in it oxidize and become darker.

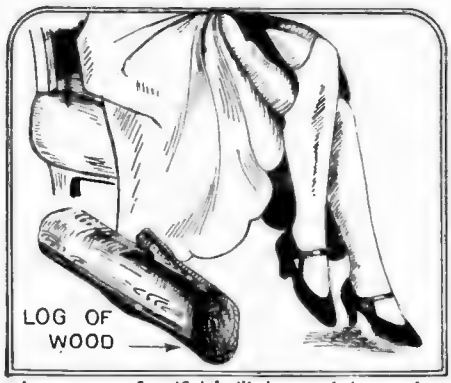


A new anti-freeze radiator compound uses a 35% solution of ethylene glycol in water.

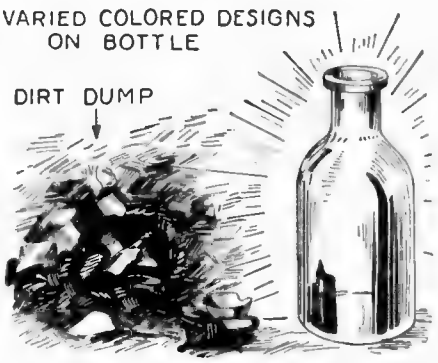
A metal that vaporizes very slowly at room temperatures is mercury. The vapors cannot be seen.



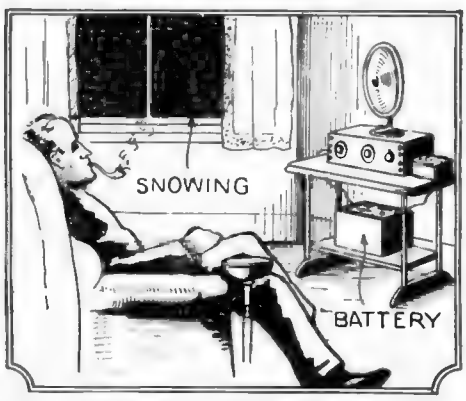

The Germans are considered to be superior chemists because chemical research is encouraged. Thousands of dollars are invested in chemical laboratories by capitalists interested in finding new processes.



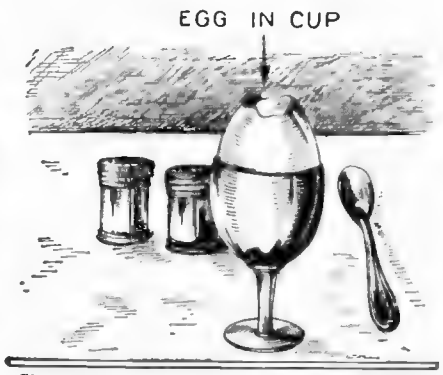

A new type of artificial silk is now being made from wood. It is a very good product having many advantages and the process of making it is strictly a chemical one.




Because of the action of alkali soil on glass surfaces, buried bottles often become very beautiful, reflecting the light in rainbow colors.

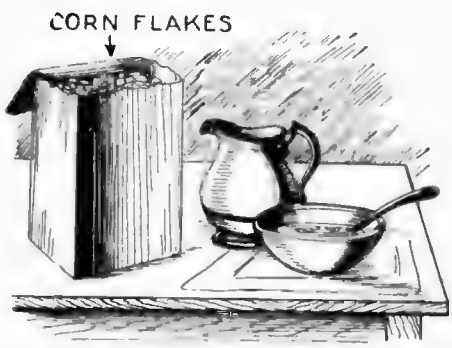



By melting clean snow and bottling the water so obtained, one may procure enough distilled water for his radio and car batteries to last all summer.



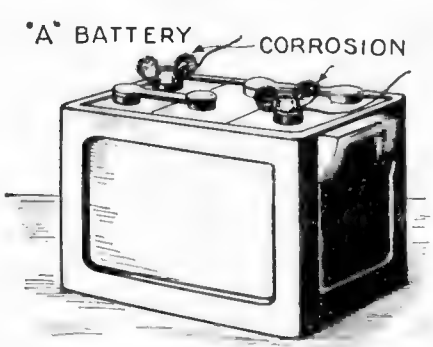

Chemically, eggs are all alike and the belief that dark colored eggs are richer has absolutely no foundation.

Milk of magnesia tooth pastes usually consist of little or nothing more than milk of magnesia mixed with glycerine in proportions to obtain the desired consistency.




The paper surrounding cereal boxes is not always waxed but is sometimes made by coating the paper with water-glass solution making it grease-proof and keeping it from soiling.

Formerly mercury was used in an amalgam with tin for application to a sheet of glass in order to produce a reflecting mirror. Metallic silver, deposited chemically from its compounds is now used.

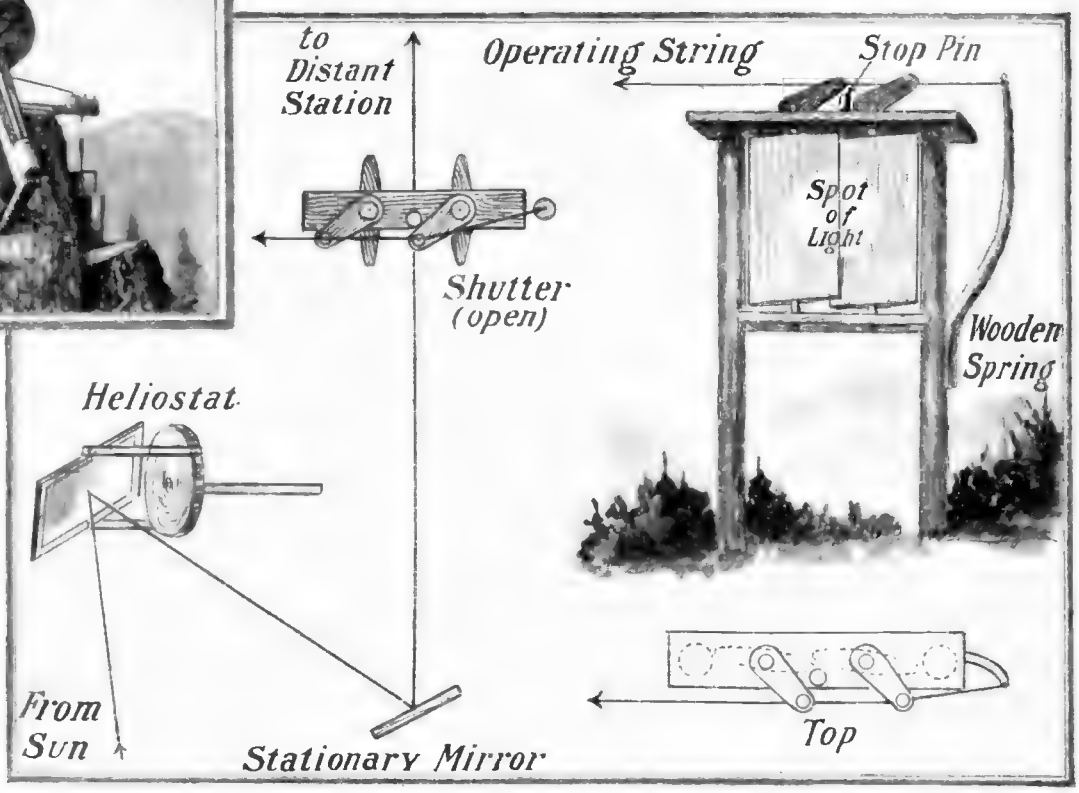



The green corrosion is principally copper sulphate formed by the acid attacking the brass bolt or the copper wire. It should be scraped off and the metal coated with vaseline.

# THE CONSTRUCTOR

## Simple Home-Made Heliograph

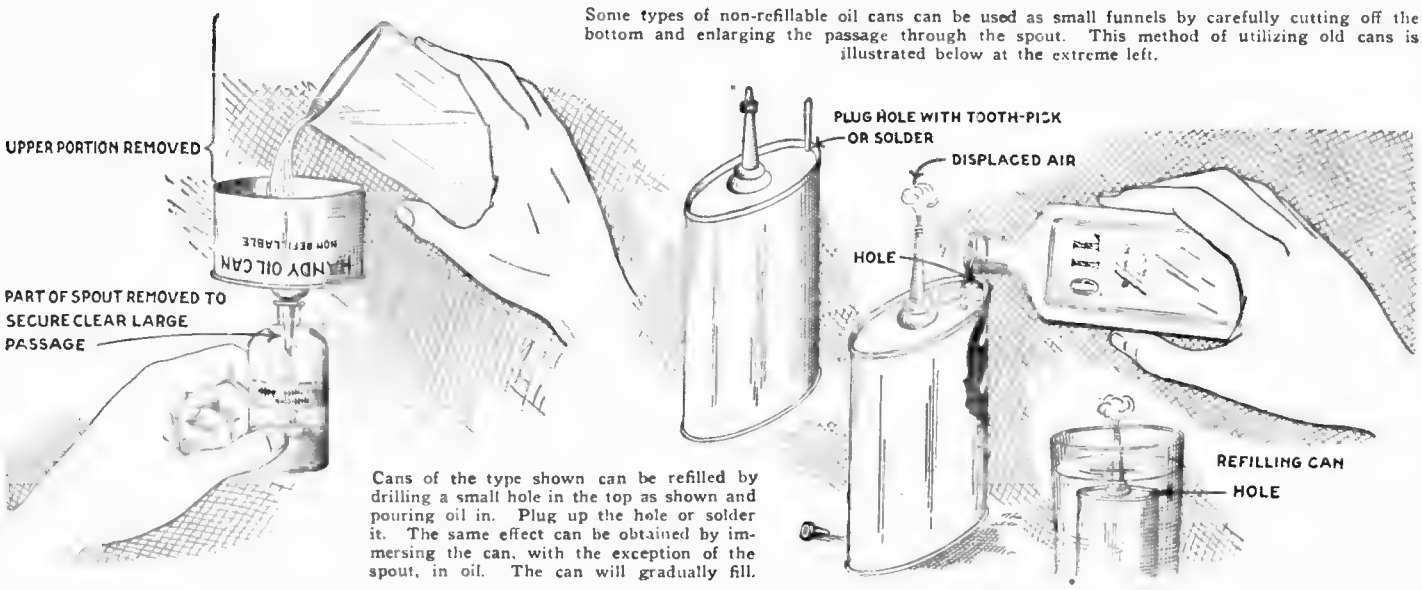
The details of the shutter for this novel heliograph are shown in the drawings below. Two shutters are used and are controlled by means of an operating string. In the heliograph itself, two mirrors are used. One reflects sunlight to the other and the latter projects beams toward the receiving station. With this device, communications can be carried on over 40 or 50 miles if the air is clear.




In order to have the first reflecting mirror of the heliograph, called the heliostat, follow the sun, the old water clock principle is employed. One can, shown beside the stump in the photograph above, is filled with water. The inner one is weighted with rocks and a small hole in the bottom allows it to sink gradually in the water. The speed at which the heliostat travels in keeping up with the sun is regulated by placing more or less pebbles in the inner can. The rest of the details can be gleaned from the photographs and the drawings. When the small can hits the bottom, pour the water out, being careful not to lose any of the pebbles. —Britley A. Ball.

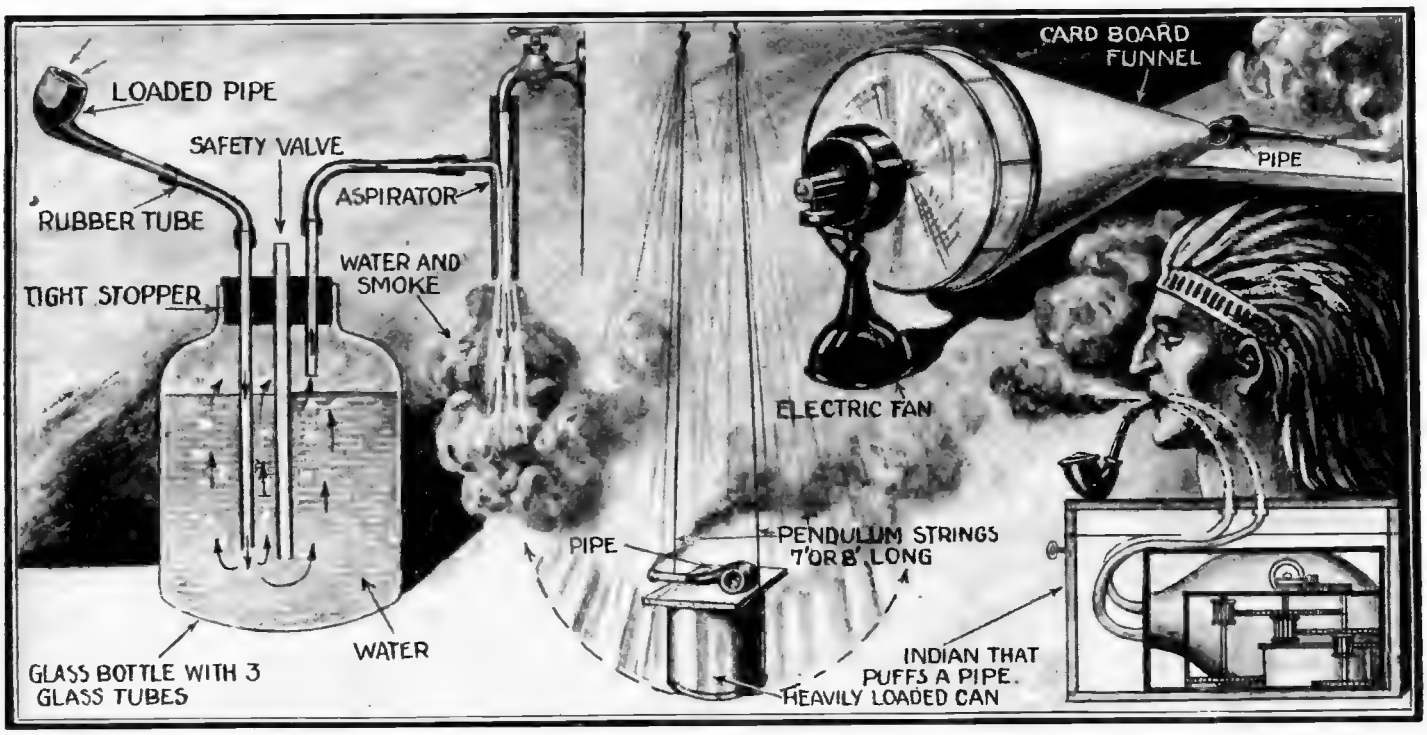
## Using Non-Refillable Oil Can

Some types of non-refillable oil cans can be used as small funnels by carefully cutting off the bottom and enlarging the passage through the spout. This method of utilizing old cans is illustrated below at the extreme left.




Cans of the type shown can be refilled by drilling a small hole in the top as shown and pouring oil in. Plug up the hole or solder it. The same effect can be obtained by immersing the can, with the exception of the spout, in oil. The can will gradually fill.

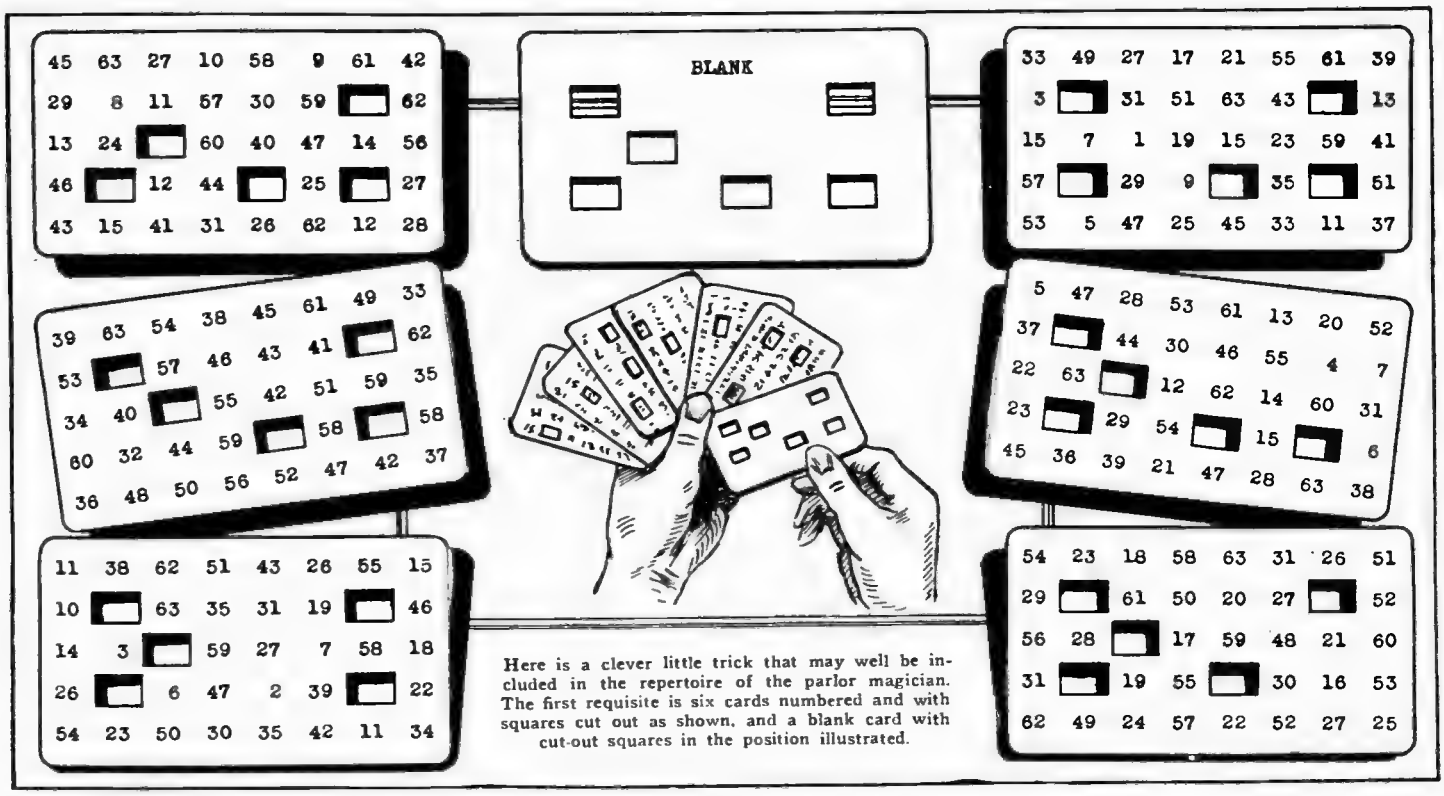
# Breaking in the Smoker's Pipe




The devices shown above are for the purpose of eliminating the necessity of a smoker actually puffing on his pipe until the bowl is caked. The first device at the left makes use of a small water operated suction pump or aspirator connected to the pipe through a jar of water as shown. After the pipe is loaded, turn on the water and light the pipe. It will be smoked steadily. Another method is shown in the center. Lay the lighted pipe on a heavy extemporized pendulum and allow it to swing for some length of time. The air currents set up will puff the pipe. A third method uses an electric fan and a cardboard funnel which directs a breeze into the bowl of the pipe. A tobacco store advertising device is shown in the lower right corner. The image "smokes" the pipe by virtue of an inflated and deflated bulb operated by a simple clockwork. The mechanism, actuated by a spring, rotates a cam. The edge of this cam alternately presses and releases a piston which in turn periodically compresses a rubber bulb. Using any of the described and illustrated methods, a few pipes full of tobacco may be "smoked," thereby eliminating the raw taste of the wood before the smoker actually puffs on the pipe.

—Harold F. Richards. Ph.D.

# Mysterious Number Cards

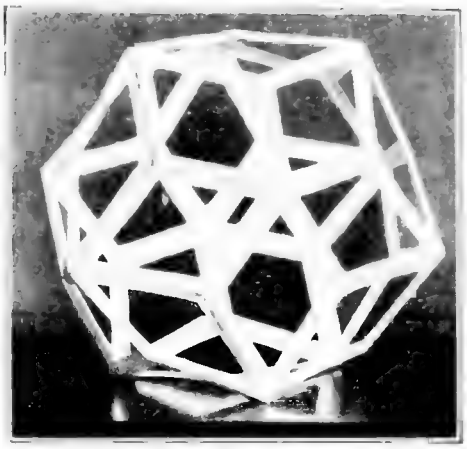



Here is a clever little trick that may well be included in the repertoire of the parlor magician. The first requisite is six cards numbered and with squares cut out as shown, and a blank card with cut-out squares in the position illustrated.

After a set of seven cards as illustrated above are carefully made, which may be done by removing this section of the page, pasting it on cardboard and then doing the necessary cutting, any number thought of by one of the audience may be detected by the magician if the following procedure is carried out. Hand the six cards to the spectator, retaining the blank one. Request him to return to you all cards having printed thereon the number of which he thought. Place these cards one over the other in any order, put the blank card on top of the pile and the sum of the numbers visible through the various open spaces on the blank card will be the number thought of.

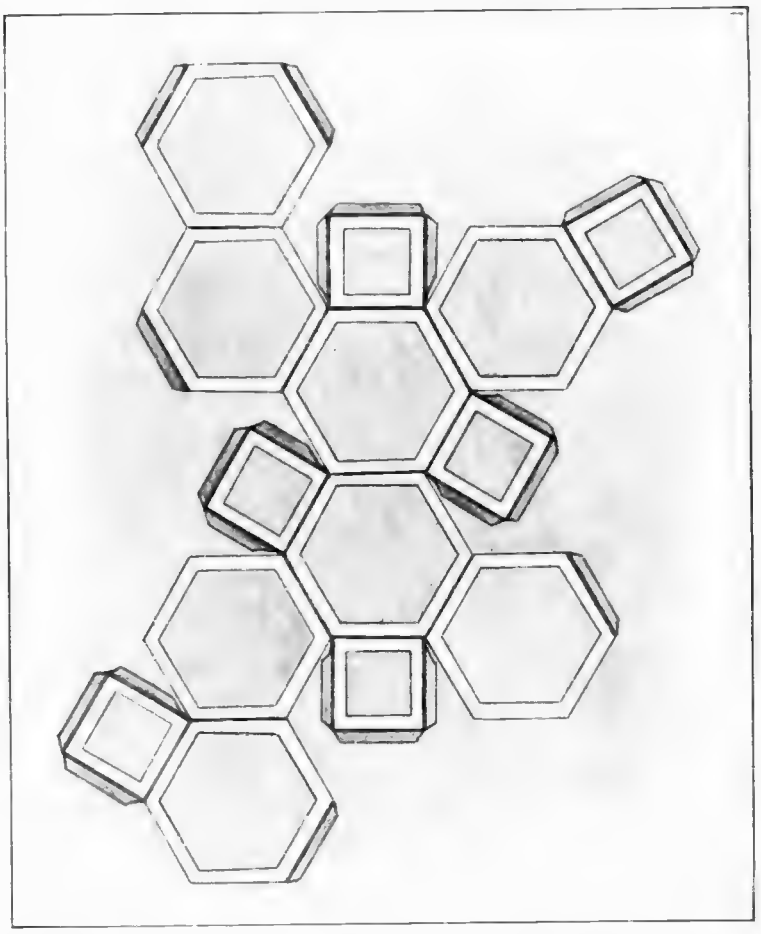
—Chas. D. Tenney.

# Paper Models of Crystal Structures

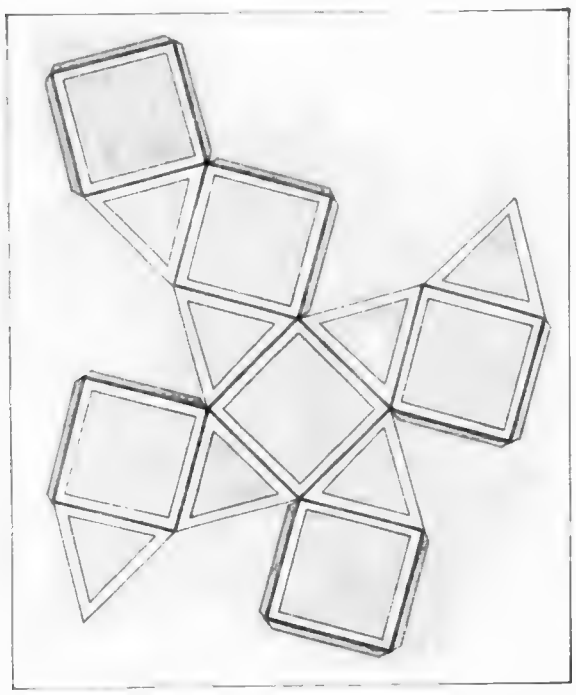


The above photograph shows a very interesting paper model of a typical form of crystal. It will be noted that the faces have been omitted, and but a narrow strip of paper is left along the edges. It is surprising to note the strength of these models.

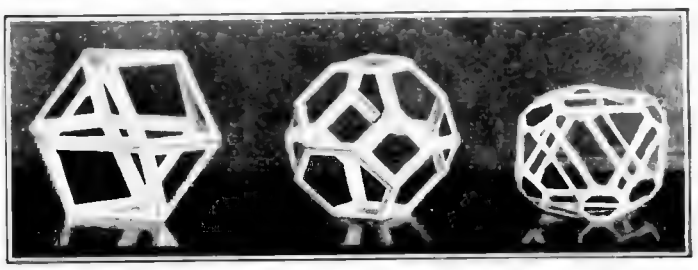
The method shown in the photo at the right is also adaptable to making crystal motives for ornamental purposes. Lanterns and lamp shades lend themselves admirably to such purposes. They are incidentally frequently used for instructing students in the science of crystallography. They are easily constructed being made of one sheet of paper.



The crystal in the center of the photograph below was constructed as indicated in the diagram above. It is made entirely of one sheet of paper and cut out with a pair of scissors or safety razor blade. Flaps are left for gluing.

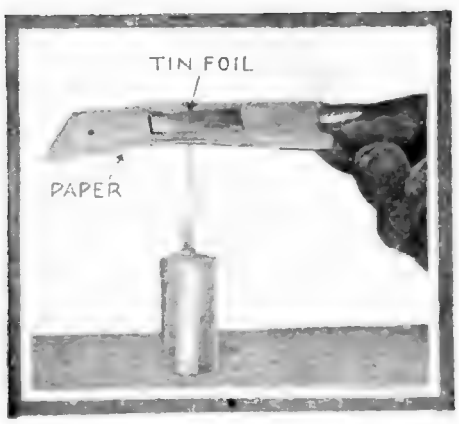


The diagram above shows how another kind of crystal is made. The heavy lines indicate the folds. This crystal is likewise illustrated in the photo at the right. In making crystals from cardboard, the bend must be cut half through with a razor blade.



Photos above illustrate three different types of crystals. A complete set of models of this nature are very valuable to the instructor in crystallography. The open windows in the faces of the crystals permit students to make good drawings of the same. —A. Gruntal.

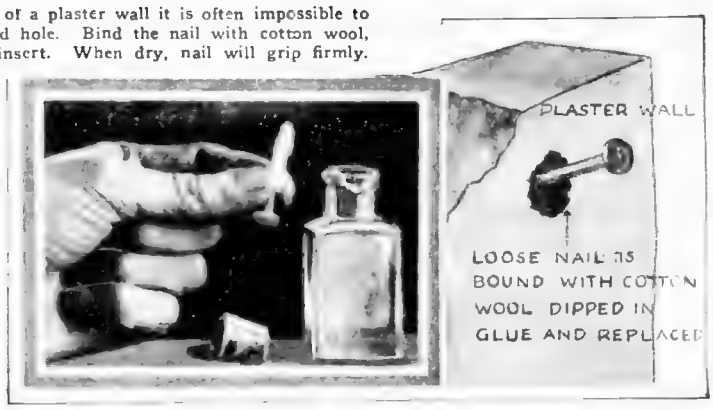
## Experiment in Heat




Left: An experiment in heat conduction. Tinfoil will melt on cardboard, but the cardboard does not burn. The foil absorbs all the heat. —S. L. Bastin.

## Making Walls Grip Nail

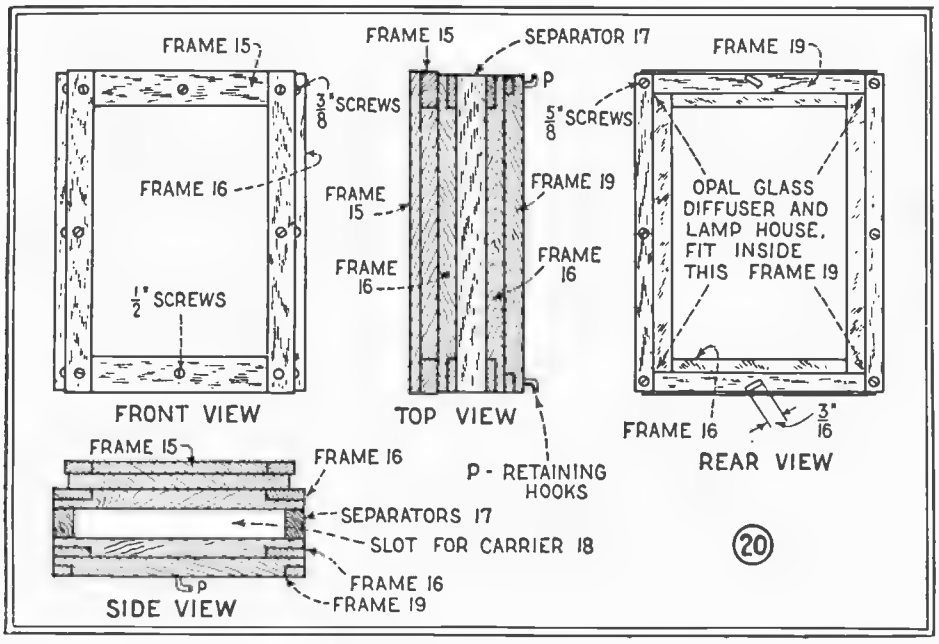
When a nail comes out of a plaster wall it is often impossible to get it to grip in the old hole. Bind the nail with cotton wool, soaked in glue, and reinsert. When dry, nail will grip firmly. —S. Leonard Bastin.

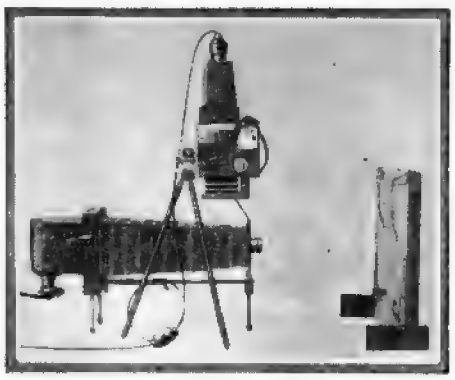


# An Enlarging Machine for $5.37

## With a Lens as Fine as That on Your Pet Camera

By R. A. CHATH



The photograph above shows the home-made enlarger described here, in comparison with a manufactured type of standard design. Fig. 1.

The drawings at the left give details and dimensions for the construction of the negative holder and the light diffuser for use in connection with a lamp housing and a standard camera, the combination making an excellent type of enlarging device. See text for complete description.

HOW many times have you turned out an especially fine negative, nicely composed, full of detail, needle sharp, and then lamented, *sotto voce*, "Gosh, if I only had some sort of enlarging machine, I'll bet I could run that up to a sixteen by twenty." Doubtless you could, if the enlarger had a fine lens, which most of them haven't unless you want to pay upward of $35.00. However, if the directions below are followed, you will soon possess an instrument which will equal the work of any of the high priced machines, at a cost of $5.37 and some elbow grease.

The adapter to be described is secured to the rear of the camera in place of the plate holder or camera back; thus you are enabled to make use of your fine *taking lens*, and the most important and expensive item of an enlarging machine is taken care of, at a cost of absolutely nothing.

One of the most interesting features of this outfit is its compactness. The whole set-up, in the 2¼×3¼-inch size, may be mounted on a very small card table (Fig. 1) and the attachment itself can be packed away in a good size cigar box.

The particular attachment detailed below was designed for use with the Auto Graflex Junior, but may be readily adapted to most 2¼×3¼-inch cameras by slight modification, as will be described later. The general dimensions can be expanded to accommodate larger cameras very easily, but care should be taken to make the wood parts heavier if the size is increased a great deal.

First, go to the hardware store and purchase a piece of sheet tin or roofing tin and a piece of thin opal glass about 3½×4½ inches. Be sure it is free from bubbles and scratches. Now get the following: flat head (brass) wood screws, size No. 1, 6⅝ inches long, 6⅜ inches long, 8½ inches long and 4¼ inches long. Now secure two round head (brass) wood screws, size No. 1, ¼ inch long, two small screw eyes, same size shank as above screws; a small can of hot-pipe aluminum paint and a small can of dull black iron enamel. Get two small round medium stiff brushes, a small can of strong, quick drying glue and two sheets of fine grit, garnet or sandpaper. That will be all at the hardware store. Next, go to the electric supply shop and get an attachment plug complete, separable cap and body, 8 feet of silk-covered duplex lamp cord and one 110-volt keyless electric light socket, brass body, with threaded end for shade holder; an insulating bushing for wire end of socket and a Uno No. 501 shade holder. This type is the only one which will answer. A 50-watt, short body, mill type, tipless P19, Mazda B electric light bulb and one through cord, push-button switch, similar to the Cutler-Hammer No. 7050, complete the purchases.

Cut out Figs. 3, 4, 5, 6, 7, 8, 9 and 10 and take them to your local pattern maker, carpenter or lumber yard. After you have located your man, tell him you want one strip each, exactly as shown, of clear, straight-grained mahogany, smooth finish all over and dead to size. Don't let them tell you that the wood can't be cut to such close dimensions. It's easy enough to do, but many of these artisans are too lazy and careless to attempt the work, except under strict orders from the customer. A dollar and a half is plenty for this job, so don't stand for any profiteering. If you can't get mahogany, take birch or cypress, if it is thoroughly dry. Right here let me say a word about mahogany. Most people have an idea that it's as hard as a rock, and very difficult to cut. As a matter of fact, though it is classed with the hard woods, the ordinary commercial variety is not at all hard and may be easily handled.

Well, now, you have $5.37 worth of material that's got to be put together, so right here is where you start to use the elbow grease. The first things to get busy on are the wooden parts, the negative carrier or printing frame (Fig. 18) and the adapter body (Fig. 20). You will note that the negative carrier is made up of the strips 8 and 9, while the body is made up of the four frames and two separators (Figs. 15, 16, 17, 19), which are, in turn, made up of the strips 3-4, 5-6, 7, 5-6 and 10-10. With the aid of the scale, square and scriber or sharp pencil, mark off the strips to the required length, leaving about $\frac{1}{16}$ inch between sections to allow for the saw slot. For example, take the front frame (Fig 15), composed of strips 3 and 4; cut off two lengths of strip 3 a full $4\frac{1}{16}$ inches long and two lengths of strip 4 a full $3\frac{1}{2}$ inches long. Follow this example with the other strips until you have them all cut to length.

The next operation is to cut and fit the half check joints (Fig. 11). These are the easiest sort of joints to make and when properly assembled are surprisingly strong. Mark off exactly where the joint is to be made, taking care that your lines are square. The cross-grained cuts should be made with the fine saw to the required depth and the section to be removed cut away with the knife.

After you have the joints for one frame cut and fitted, you can glue it up and let it dry while you are working on the next. The joints should be covered with glue, placed together and securely clamped to one of the wood blocks by means of the small steel clamps. There are three precautions to take when clamping up the frames. First, don't place the frame directly on the wood block, as some of the excess glue may ooze out, get between the frame and the block and may make it next to impossible to separate them. This trouble may be obviated by placing a couple of sheets of paraffin paper between the adherents. Second, place an even slip of wood between the clamp and frame, so that the surface of the latter will not be marred by the pressure of the screw end. Third, be sure to check the angles with the steel square.

You are now ready to glue the frames together. The two frames 16 should first be glued to the separators 17, forming the guide in which the negative carrier sides. Be sure to test this latter fact before gluing and see that the carrier actually does slide through freely. Before gluing up any more sections, drill holes for the six ⅜-inch screws in the front, or frame 15 side of this assembly, as this same frame 15 partly covers the screws when it is assembled in place. Countersink the screw holes slightly with the point of the knife, to allow for the heads. A bit of soap rubbed on the screws before insertion will make them go in easier and tend to prevent splitting. Frames 15 and 19 are next glued up in the same manner, additional strength being secured by the insertion, respectively, of the eight ½-inch and the six ⅝-inch screws. Fig. 20 shows the assembly quite clearly and the builder should experience little difficulty in constructing a solid, fine looking job. If you desire, four ¼-inch screws may be inserted in the corners of the negative carrier (Fig. 18), but as the wood parts are so small, this

will probably tend to weaken rather than strengthen the frame.

Having completed the wood parts, clean up all the joints with the file and sandpaper, rubbing down until the finish is smooth and free from roughness. Give the parts a level coat of black enamel and set away to dry.

Next on the program is the lamp house. Fig. 21 shows the layout of the part and Fig. 22 gives an idea of how it will look after bending up. First, take your scale, square and scriber and lay out the design exactly as shown in Fig. 21. Using the tin-snips or strong scissors, cut around the outside lines and the central hole. This hole is for the shade holder, which should next be taken in hand.

Again using the tin-snips, cut off all the ring which supports the screws for clamping the shade. Continue cutting on the flange until you have a ring $1^{11}/_{16}$ inches in diameter (Fig. 22). This will remove the part having a ring of small ventilation holes and will leave you a solid, narrow flange and threaded portion. This should be securely soldered in place in the hole in the lamp house, with the threaded portion placed in such a manner that it will project inward when the house is bent up. Next, place the tin lamp house layout with the line *a* exactly over some sharp, right-angled edge, such as the end of a table—a metal edge would be better. Clamp the tin securely in place by means of the wood block and steel clamps and hammer the ⅛-inch flange down until it is perpendicular to the main portion. Continue this same operation with the lines *b*, *c* and *d*, and then with the lines *e*, *f*, *g* and *h*. The same general idea should then be followed with the edges *i*, *j*, *k* and *l*, except that the bends should not be quite as acute—you will note that the sides taper somewhat. Be sure to bend *i* and *j* before you do *k* and *l*, otherwise you will have considerable difficulty in getting the side flanges in their correct place. Finish up the job by soldering the flanges *e*, *f*, *g* and *h* to their respective adjoining sides and you will have a box-shaped arrangement, something like Fig. 22. In regard to the soldering, though both the shade holder and flanges can be easily soldered with a soldering iron in the hands of an operator of some little previous experience, the best thing for the novice to use is some sort of blow torch or Bunsen burner. A small blow pipe and alcohol burner will answer admirably. These may be purchased for about 50 cents in most hardware stores if the builder is not already provided with them.

The use of a prepared solder paste will facilitate matters, as it melts easily and flows freely. The joints to be soldered should be smeared thickly with the paste on both the adjoining surfaces. The flame of the burner is now applied by blowing through the blow pipe until the solder is thoroughly liquified. At once press the joints together firmly and hold securely until the solder has a chance to cool and harden. If the above-mentioned type of paste is used, the job should be scrubbed off with wood alcohol to remove the excess of flux. Too small pieces of ⅛-inch square wire (Fig. 22) are now soldered in the position shown. These are for the retaining hooks (p, Fig. 20) to press against. The wire referred to is that used for hooking up radio receiving sets; it is called bus wire. No doubt any of your radio friends can supply you with an inch or so. A coat of aluminum paint inside and one of the black enamel outside finishes the lamp house.

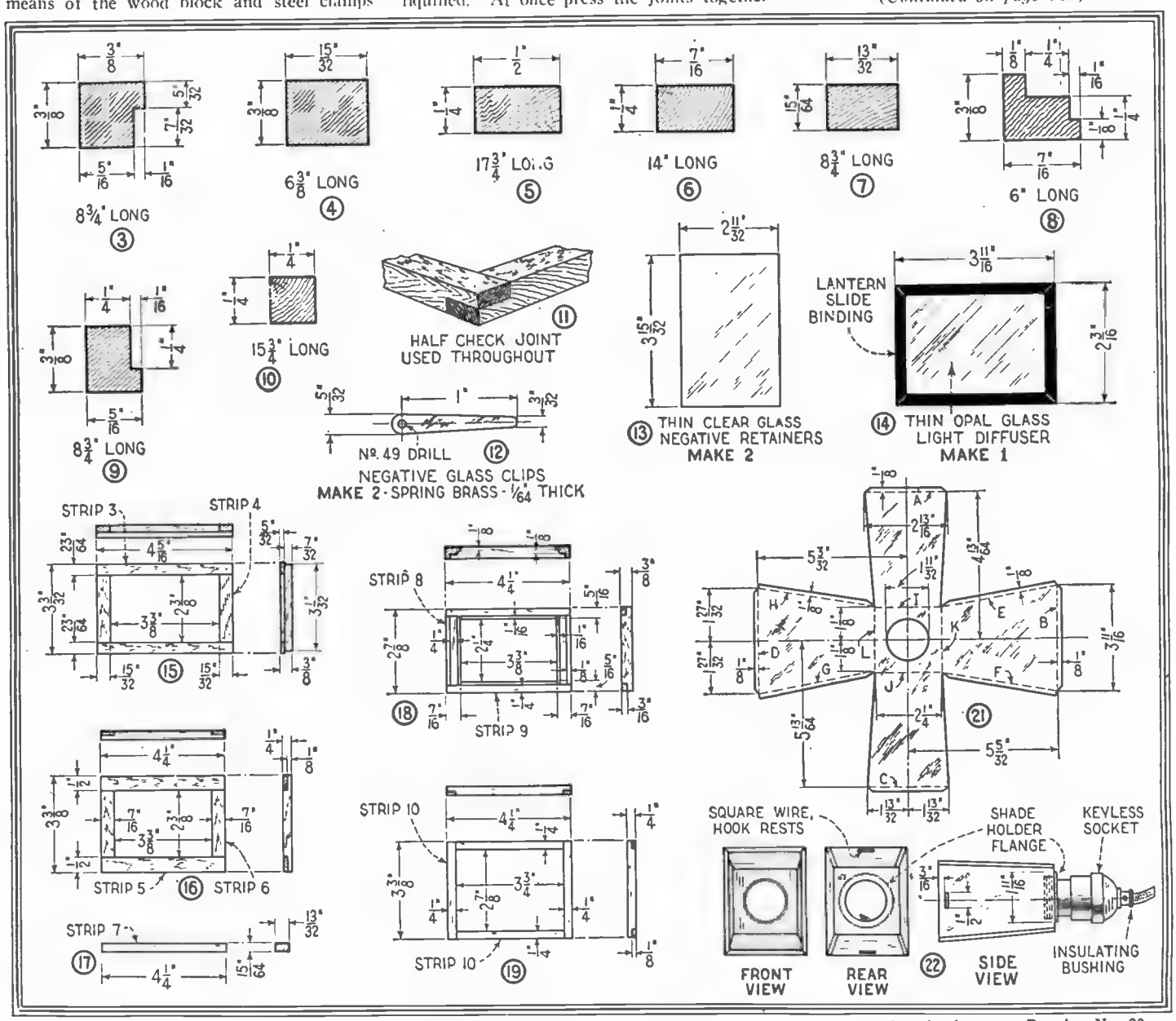
After you have gotten this far, the rest is plain sailing, so take your glass cutter and finish up the light diffuser, as shown in Fig. 14. Bind it with lantern slide tape or narrow strips of *passe-partout*—and that's done.

Next, get two old photographic plates, wash the emulsion off with hot water and cut to the size shown in Fig. 13. These are the negative carriers and should be free from scratches and bubbles.

The little retaining hooks previously mentioned should next be made from the two small brass screweyes. Heat the eyes red hot in a gas or alcohol flame to anneal the wire and then, after cooling, bend into the shape shown in Fig. 20.

The only thing left to make is the set of clips for the negative glass. These clips

(*Continued on page* 969)



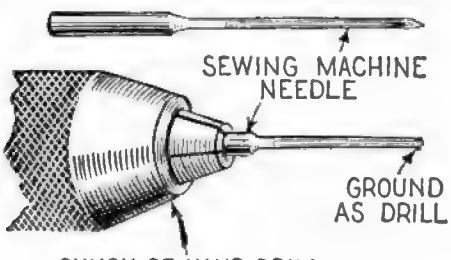

The various drawings directly above show the remaining details for the construction of the various parts of a photo enlarger. All of the numbers on the drawings correspond to those given in the text. Drawing No. 20 is on the preceding page; other pictures in continuation.

# WRINKLES

## RECIPES & FORMULAS

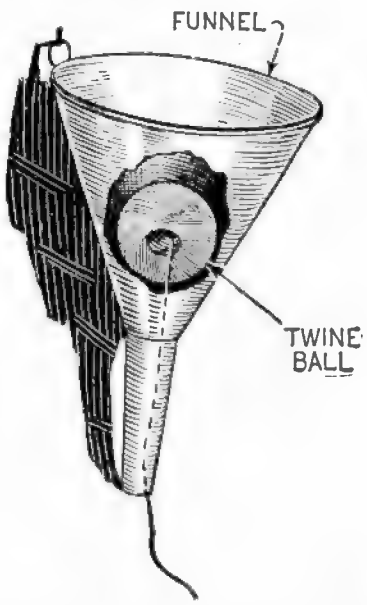
Edited by S. Gernsback

### Emergency Drill



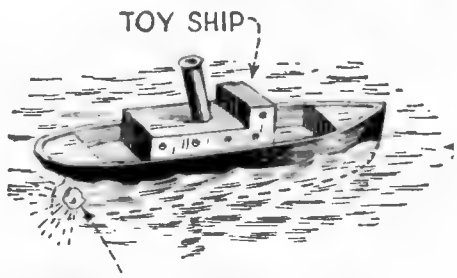

When a very small drill is necessary for fine work, one can be made from a sewing machine needle that will give excellent service. The point is broken off and the stub is ground on an emery wheel to the same shape as the end of an ordinary drill. —S. G. Garbutt

### String Holder




A ball of string or twine left to its own devices will often be lost. If, however, it is placed in a funnel and the cord threaded through the bottom, the cord can be used as desired and the supply will always be in its proper place.
—Mrs. Nina Jeffers

### Toy Ship

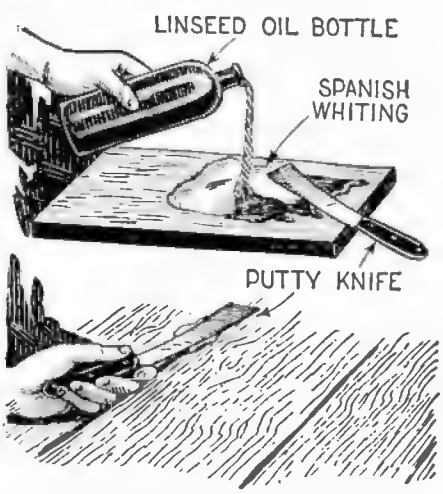



If a light toy boat is constructed after the fashion shown above and a bit of camphor is fastened to it, the boat will zigzag slowly through the water until the camphor loses its power of changing surface tension.
—Author please send address

### Handling Wash Tubs

An 8-foot piece of hose will lighten the labor of wash day when movable tubs are used. The hose can be used to siphon off the water from the tub or to siphon water from some other container into the tub. —Mrs. Nina Jeffers

### Crack Filler




If Spanish whiting is mixed to a thick paste with linseed oil it makes an excellent crack filler. Paint the cracks and when dry, fill them, using a putty knife. Then paint in the usual way.
—Mrs. Nina Jeffers

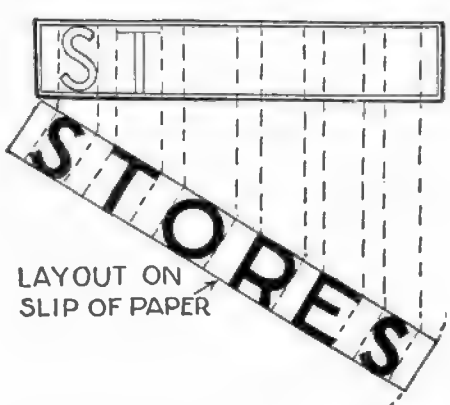
### Tree Spray

Fruit growers often lose valuable trees and fruit through attacks of various kinds of fungi that are detrimental to the well being of the trees. In cases of this nature, a home-made spraying liquid that is very effective in fighting these growths can be made up as shown above. Water, powdered sulphur and unslaked lime are mixed together in the following proportions: One quart of boiling water to one ounce of each of the solid materials. The resulting liquid is applied to the trees through any type of sprayer available. It should be filtered and cooled before using.
—L. V. Bergman.

### Stiffening Brushes

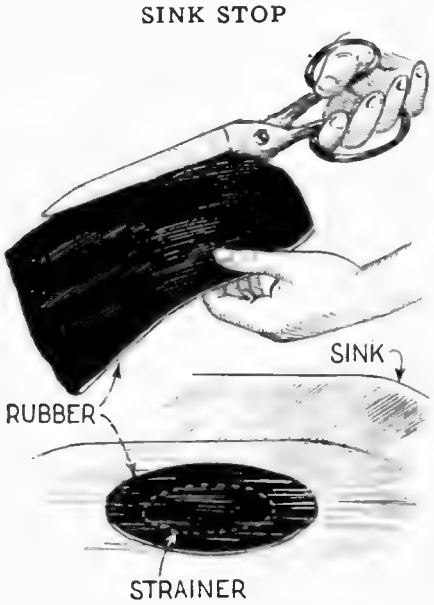
When the bristles of hair brushes have become soft through repeated washings, they may be stiffened again by dipping in a strong solution of alum and then drying quickly by means of heat. If necessary, the dipping may be repeated. —Mrs. Nina Jeffers

### Letter Spacing




A certain series of letters may be made to fit any given space if the series is first laid out on a strip of paper and projected upon the required space as above. All letters will then be in the correct proportion.—August Jeffers.

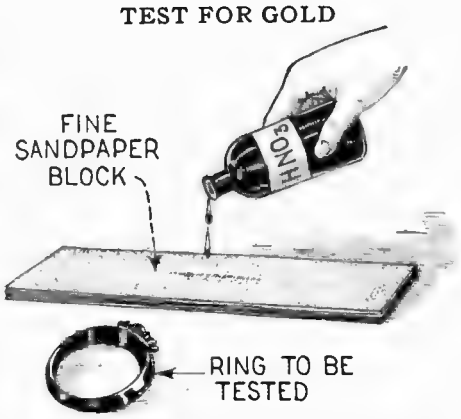
## SINK STOP




If a disk of rubber is cut from a piece of inner tube, it can be used as a stopper for the outlet of a sink. Dip the shears in water before cutting the rubber. The disk will lie flat under the pressure of the water.

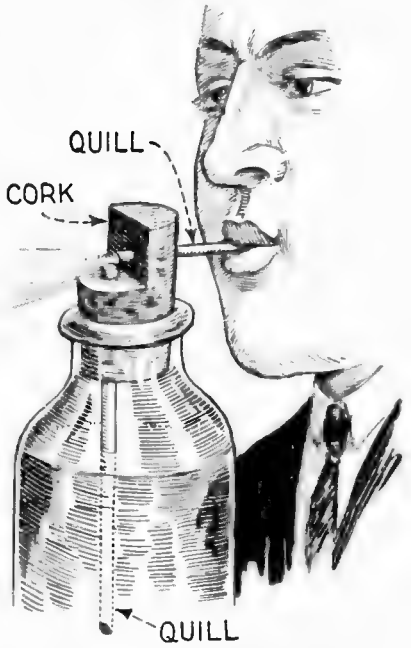
—Chester Lyndelle

## TEST FOR GOLD



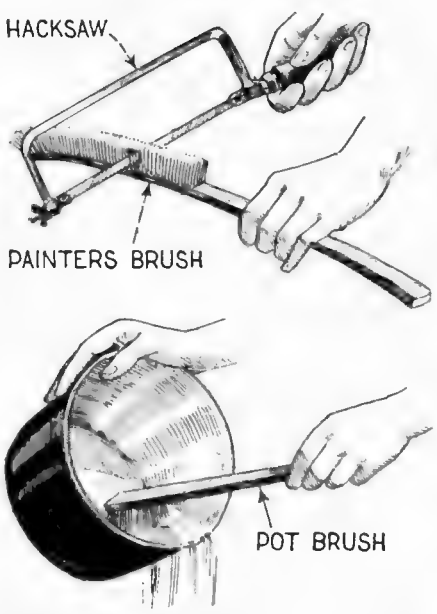

To test for gold, rub the object on a fine sandpaper block, apply nitric acid to the streak. There will be only a lessening of the yellow color if gold is present, but if not, a greenish blue color will result. —F. R. Moore

## ATOMIZER




A simple atomizer may be made of two quills and a cork cut to the shape shown above. Blow through the horizontal quill to vaporize the liquid in the bottle. —William McGauley

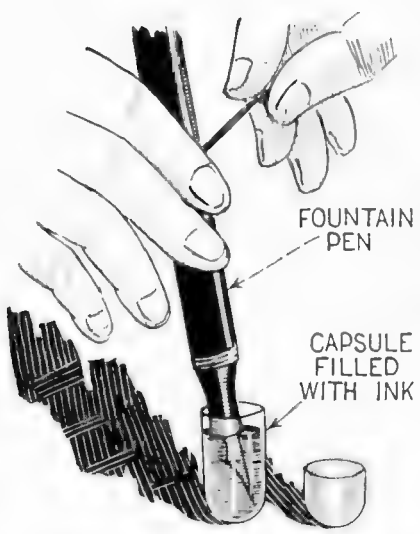
## DOUBLING A BRUSH




Brushes for scrubbing pans and for peeling vegetables are often hard to locate. If a painter's wire brush is obtained and the wires are cut off to the desired length and the brush cut in half as above, two useful brushes will result.

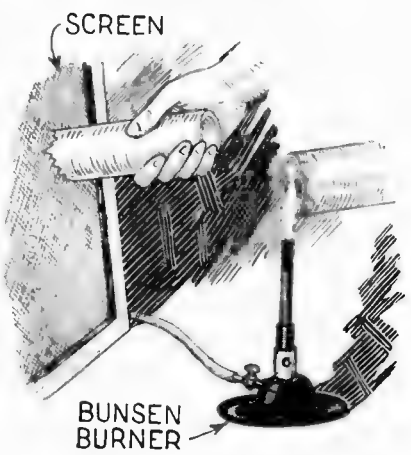
—Chester Lyndelle

## PEN FILLER




In case the handle of the self-filler is so low on the barrel that the pen cannot be introduced deeply enough into an ink bottle, fill a gelatin capsule with ink as above and then fill the pen from the capsule. —Maurice Berger

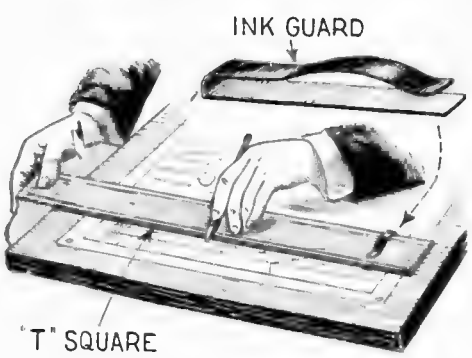
## GLASS TUBE WRINKLE




To smooth off the jagged edges of a glass tube after it has been cut, stroke the end downward on a piece of wire gauze and then finish smoothly by heating in a flame.

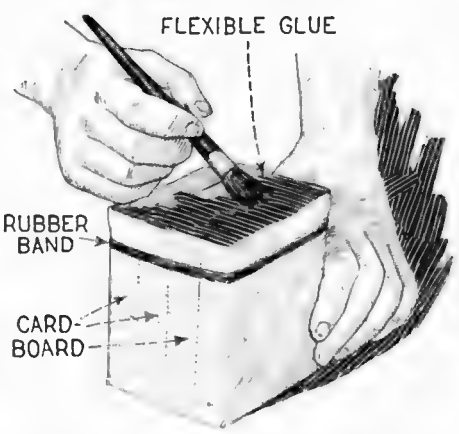
—Robert W. Garis

## INK GUARD




If a clip is made up from a clip of spring steel or brass in the shape shown above, it can be placed over the end of a T square, enabling the draftsman to work over wet ink without smudging. The lower strip holds the T square up from the paper. —James Davis

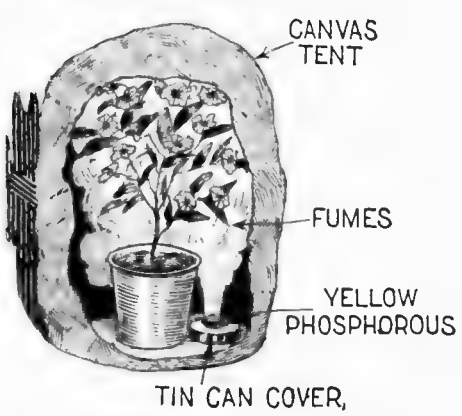
## SCRATCH PADS




Scratch pads made up of waste paper that is clean on one side can be easily made. Separate every hundred sheets with a piece of cardboard and bind with rubber bands. Apply flexible glue to one edge and after it dries, remove the rubber bands and separate the pads. It is advisable to stretch a piece of cheese cloth over the glued surface in order to give strength.

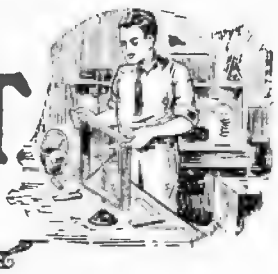
—Kenneth Bronaldo Murray

## INSECT EXTERMINATOR

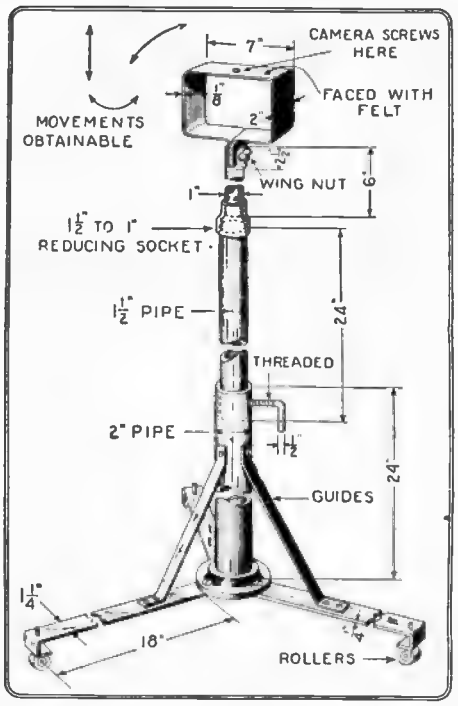



When insects infest plants, cover the plant with a canvas tent as shown and burn yellow phosphorous under it. The phosphorous pentoxide will envelope the plant and exterminate the insects. —William M. Goldberg

# HOW TO MAKE IT



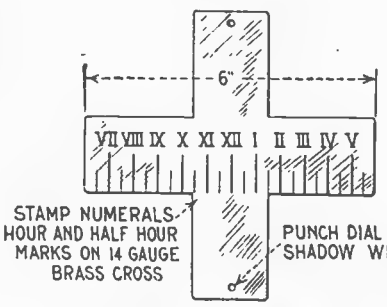
## Camera Tripod

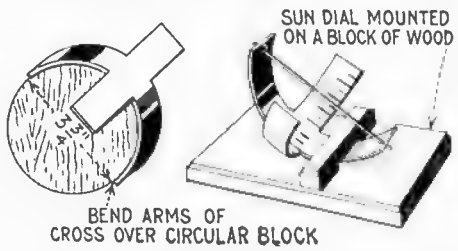



A tripod stand for the studio that is very rigid and adaptable to most cameras can be made from pipes and pipe fittings as shown above. The height of the tripod is regulated by means of the telescoping tubes. The strap iron guides shown are not absolutely necessary but they increase the rigidity of the entire tripod. The type of top shown gives a tilting capacity when desired, thus increasing the utility of the stand.

—Raymond B. Wailes

## Sun Dial

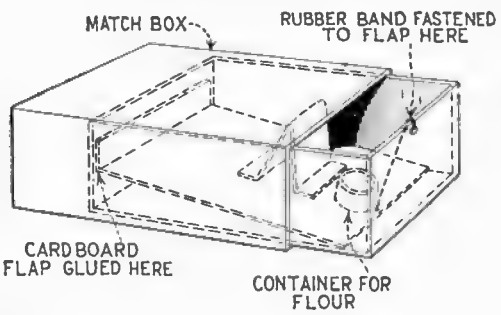



To make a fairly accurate sun dial, cut out a cross of 14 gauge brass and stamp or etch hour marks on it as shown, making the hours one-half inch apart. Then drill two holes for the shadow wire and shape the cross arms around a 3¾-inch form. Mount as shown and put in the shadow wire. Set the sun dial in a level place with the entire length of the shadow wire in direct line with the north star.

—Harold A. Fidler.

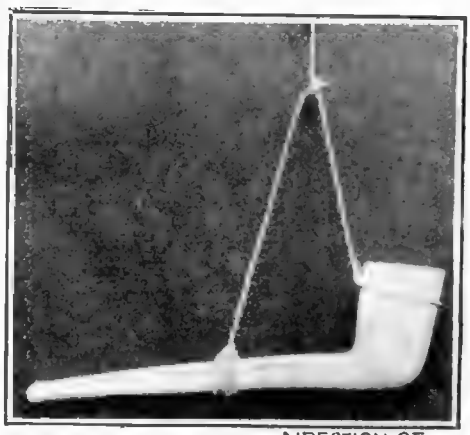
## Surprise Match Box

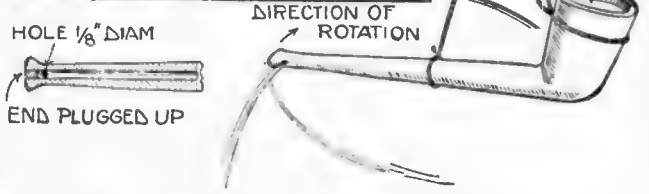



A trick match box that will fool your friends and afford much amusement can be readily made in a very few moments. Glue two bent strips of cardboard in the slide of a match box as shown above. Arrange a rubber band so that it tends to pull the flap upward. However, the triangle of cardboard holds the flap down when the box is closed but upon opening, the rubber band pulls the flap upward and catapults the flour from the cup.

—Alden Henry Johnson

## Model Water Turbine

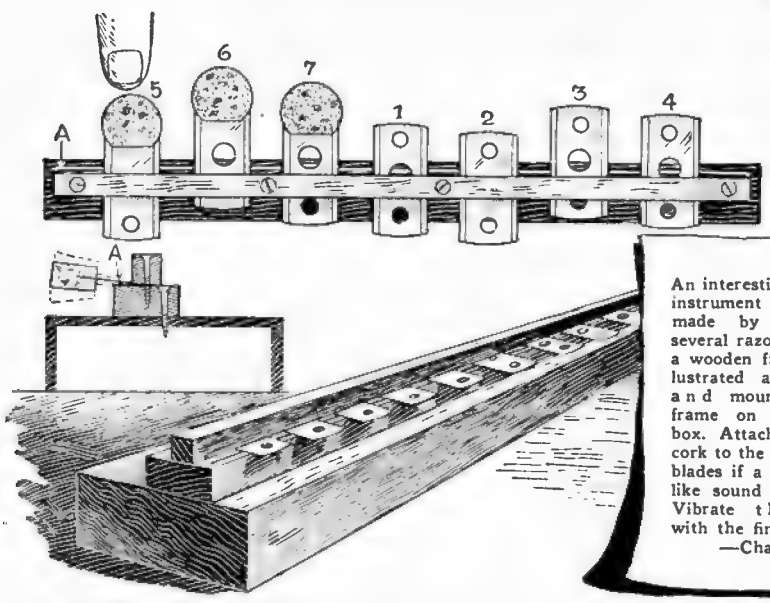





A most interesting working model of a water turbine can be made up in a very simple manner with the aid of a clay pipe and a few pieces of cord. First, the mouthpiece of the pipe stem is plugged up with sealing wax and a horizontal hole is drilled through only one wall of the stem. The pipe is then mounted in a sling made up of short pieces of string and another cord about 15 inches long suspends the potential turbine from any suitable point. If water is poured into the pipe bowl, a jet will escape through the hole at the side and the reaction will rotate the pipe rapidly in a direction opposite to that of the jet. The principle underlying the operation of this model is exactly the same as that of water turbines of the "Francis" type.

—C. A. Oldroyd, Rep. No. 4433.

## How To Make A Razor Blade Guitar




An interesting musical instrument can be made by mounting several razor blades in a wooden frame as illustrated at the left and mounting the frame on a wooden box. Attach a piece of cork to the ends of the blades if a soft piano-like sound is desired. Vibrate the blades with the finger.

—Charles Mohr.

**SCIENCE AND INVENTION** desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 53 Park Place, New York City.

## PRIZE AWARD SUGGESTIONS

*Editor,* SCIENCE AND INVENTION:

Am a habitual reader of your interesting periodical, and I should like to be allowed to make a suggestion, the putting into practice of which, in my opinion, would increase the number of your readers on account of the attractiveness of the scheme proposed. The idea would be to reserve, say, on payment of special rates or otherwise, a column or two of your periodical, for offers coming from manufacturers, etc., desirous of improving their specialties or of adding to their line of goods something new in the way of appliances, machines, tools, devices, processes, etc. Brief indications would be given in the announcement made by aforesaid manufacturers concerning the points on which the improvements should be developed, and in the case of an article, appliance, etc., to be created, the result they wish to obtain. The address of party making the announcement would, of course, be mentioned. Any reader would be allowed to compete and to present his ideas, drawings, sketches, etc., by post. The scheme or idea finally accepted for putting the device into marketable form or manufacture would bring a reward to its inventor; the sum offered would be mentioned beforehand in the said announcement, and might amount to anything from, say $50 to $1,000, or more, according to the importance or value of the idea or invention, etc. In certain cases, in addition to the reward paid, royalties would also be granted to the successful inventor. A date limiting the period allowed during which the results should be sent, may be mentioned, and a renewal of offer made by manufacturers in case no suitable solutions of problems are sent the first time. These offers would stimulate the inventive or creative faculty of quite a number of readers, old and young, technicians or non-technicians. The manufacturer would also be satisfied, being in a position to place on the market something new to meet the public want. At the same time this scheme would be a means of supplying a little more occupation for the work shops, etc., a thing quite to be appreciated in these awkward times.

Hoping that the above suggestion may meet with your approval and that you may see a way of putting it into effect, I wish to remain,

GEORGE ROZIER.
Saint-Mande, France.

*(You have formulated a good idea which is not new, but, nevertheless, worthy of consideration. There is, however, only one way to accomplish what you have suggested, and that is if the manufacturers would deposit the prize moneys with the magazine. It is absolutely necessary that an award be made, regardless of whether the prize-winning idea is good or poor, and this is the point which is not looked upon with favor by the majority of manufacturers. Whenever prize contests are announced in magazines that are mailed, it is imperative that the awards be paid. This is a post office regulation and any bona fide magazine lives up to it. Otherwise, the life of the magazine is materially shortened. Consequently, a prize must be paid, regardless of the number of entries in the contest and, incidentally, regardless of whether the idea is practical or not. If only one suggestion is entered in a contest, the first prize must be awarded to that suggestion, even though that suggestion could never be manufactured. Many concerns award first prizes for articles which could be suited to their particular needs, or which they could make with ease. On rare occasions the contests become nation-wide and find their way into newspapers and magazines. At other times the contests are primarily intended for employees of the concerns making the offers.—EDITOR.)*

## ANTI-GRAVITATION SCREEN

*Editor,* SCIENCE AND INVENTION:

In the editorial on Gravitation in the September number of SCIENCE AND INVENTION it states that if a gravitational screen were invented, anything placed over it would remain stationary in mid-air. I always thought that if such a thing were invented, that anything placed over it would fly off into space because of the centrifugal force of the earth spinning on its axis, and would not the atmosphere directly over it fly off, too? If so, other air would rush in to take its place and the operation be repeated, so that if the screen were not immediately destroyed, the air on the earth would become so thin it would be impossible to live. I would be glad to know whether I am right or not.

JACK SWEEK,
Seattle, Wash.

*(You have a perfect right to believe that anything placed over an area affected by a gravitation screen might be thrown into space because of the centrifugal force of the earth. On the other hand, such occurrence is unlikely. Unless a gravitation screen were built of such ponderous proportions and of such a power that it would completely nullify all gravity, the object would not likely fly off into space. An anti-gravitation screen covering even an area of one square mile would soon lose its power upon an object rising for a distance of a mile or even less. At the same time the air in this particular area would rise with the object, and probably would be the only means of forcing the object up into the atmosphere.*

*In view of the fact that in nature such a thing as absolutely stable equilibrium does not exist either in the air or in the water; by that we mean a balloon will not seek a certain height and remain at that height, and a submarine will not sink to a certain depth and remain at that depth, unless the controls are constantly regulated; one could automatically assume that an object could not remain stationary in mid-air even though the anti-gravitation screen had no effect on the surrounding atmosphere.*

*Then again an object over an anti-gravitation screen has no weight. Those objects upon which gravity has no effect can really be considered weight-less. The question then resolves itself into whether or not a weight-less, mass-less object could be hurled by centrifugal force or any other force. We could not very well hurl a handful of ether at a person, and we leave the question open as to whether ether has weight or not. So you see one can probably argue as to what might occur to an object under the influence of an anti-gravitation screen for a very long time without arriving at a definite conclusion. Your question is, however, scientifically interesting because it makes people think about scientific possibilities and any question which causes people to think is valuable. —Editor.)*

## THAT STIFF COLLAR

*Editor,* SCIENCE AND INVENTION:

Your article in the June issue of SCIENCE & INVENTION magazine under the heading of "Needed Inventions" was interesting to me. In regard to the "stiff man's collar," I would like to ask you if you would be man enough to wear a different collar more comfortable if one was designed or invented?

This is in the line of my business and I have an idea of a new style of collarless shirt in mind now. I will be only too glad to put it on the market if such a market could be found for it. You mention the women and their comfortable neckwear. Well, you see women are heroines. They will put on and wear anything that is offered for sale and will discard it if it does not suit any more. Of course some men do the same, but all of them do not do so. At the present time most of them are wearing the uncomfortable stiff collar, and then occasionally cussing the missing collar button, but the stiff collar has gotten to be such a habit that the men really do not want anything different. Suppose you form a collarless club and order a few dozen shirts with comfortable collars attached, and if all the members of the club then turn out with the new style of shirt at the same time, you might set a new style in men's wear. I have the "invention" and am ready to submit it at any time.

"Sofia,"
New York City.

*(Now "Sofia" is that a nice thing to do?*

*As soon as we vote for a collar-less fad, you turn right around and ask whether we would start such affair. We also believe that the hatless fad is a good thing for health, but we did not start that. The editor is like a little boy who says, "No, you dive in first. I want to know if the water is cold."*

*Nevertheless if a really sensible men's garment were placed upon the market, there is no doubt but that our modern young men would take to the fad quickly. Balloon and bell bottomed trousers seem to have taken the country by storm without any good reason for their being worn. So why wouldn't a sensible collar-less shirt be accepted with equal enthusiasm? —EDITOR.)*

## ANTI-AIRCRAFT NETS

*Editor,* SCIENCE AND INVENTION:

In the September edition of the SCIENCE & INVENTION, on page 423 there was an article about "Anti-Aircraft Nets," and the object of the net is to foul the propeller and bring down the airplane. I think that this idea is worthless, for after one or two airplanes have been caught by the nets, all the other planes could be equipped with guards for their propellers similar to those of electric fans. I have read many interesting articles in SCIENCE & INVENTION and have found them to be of great help to me. I believe everybody that has read the magazine has also found it that way.

RAYMOND J. MILLER,
Detroit, Mich.

*(Of course your statement is true, but at the very moment that the enemy airplanes equip themselves with anti-aircraft net guards, their opponents place bombs on the bottom of the net which bombs are suitably equipped with time fuses. When the net becomes wrapped around a plane, the bombs will explode in mid-air and destroy the enemy craft.—EDITOR.)*

## AN S. & I. GEOGRAPHIC EXPEDITION

*Editor,* SCIENCE AND INVENTION:

The current copy of SCIENCE AND INVENTION (October) is the best we readers have had for quite a while. For some reason your magazine had been losing ground with me lately, but as a result of the October number my quarters are all dedicated—or rededicated, I might say—to the Experimenter Publishing Co.

Among the articles which I considered the best may I mention the one entitled "This Month's News Illustrated." This piece of work was simply a masterpiece. The drawings were of the most excellent variety while the reading matter was as good. Let us see more articles on this order. "Our Wood Supply" was also worthy of your pages, as was the "Hudson River Waterfall."

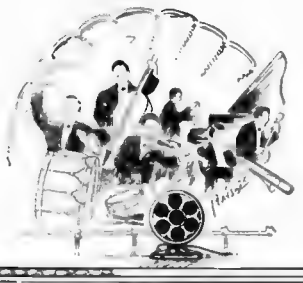
Don't you think there is a little too much Radio in the magazine? Last month eleven pages were devoted to this science. There are a few of us fellows who do not buy your paper for the Radio contained, but who buy the *Radio News*. I am quite sure you will see the logic in what I have said and dispense with a little of the Radio section.

One last word. Do you think it would be possible for the readers of SCIENCE AND INVENTION to equip an expedition somewhat on the order of the "National Geographic" parties. Of course, we could not finance a great work like a trip to the North Pole or anything like that, but I do believe it would be possible for us to send a party of men into the more or less waste places of the United States. A flag could be adopted and a constitution drawn up. Private donations could support the society. It would gratify me to hear from other readers of this subject.

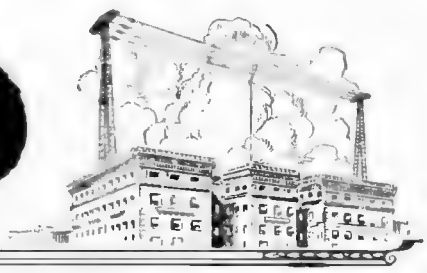
May all the success in the world attend SCIENCE AND INVENTION now and in the future.

BLAINE HOLLIMON, JR.,
Ennis, Texas.

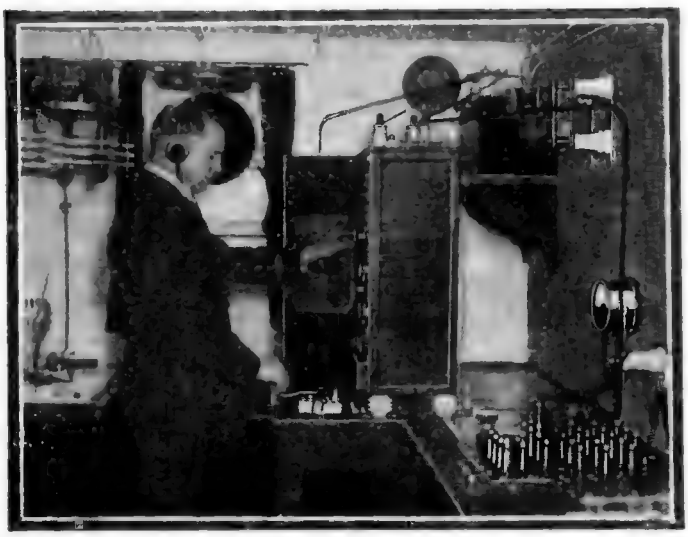
*(Now here's an interesting thought. Why not a* SCIENCE AND INVENTION *geographic expedition? We wonder what our readers would think of a proposition of this nature. We have at the present time a great many reporters all over the world who are in constant touch with some of the really remarkable expeditions now being advanced by the large scientific bodies the world over. It is in this way that the readers of* SCIENCE AND INVENTION *Magazine are enabled to get their information quicker than in many other publications. If a representative of* SCIENCE AND INVENTION *is not on the scene when a notable event takes place, the editors of this magazine wire, radio or cable him in advance to spare no expense in getting the necessary information. The idea of a* SCIENCE AND INVENTION *geographic expedition is quite unique. No doubt, it would be better to have an expedition of our own. We leave it to our readers.—* EDITOR.)



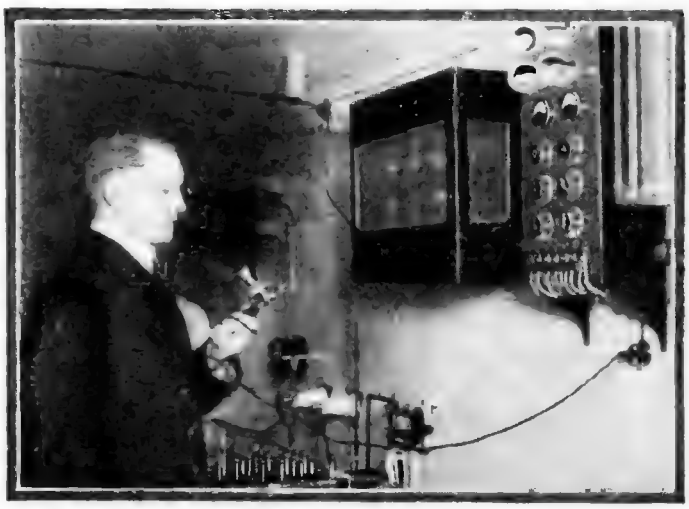
# RADIO



## Ship Radio Installation

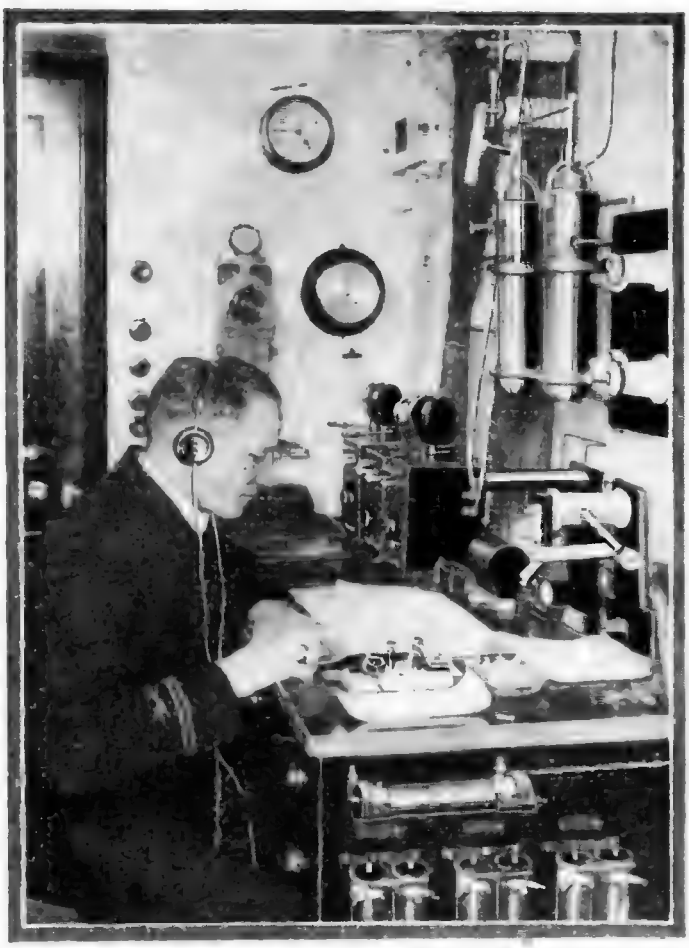


Chief Radio Officer Lindahl is shown above at the key of the continuous wave transmitter installed on the S. S. Gripsholm. In the cabinet in the center of the photograph is a one-kilowatt oscillator tube.



The Gripsholm also carries a complete radiophone installation and part of it is shown in the photograph above. This set is used for inter-communication between ships and has a daylight transmitting radius of from 400 to 700 miles, depending on weather conditions.

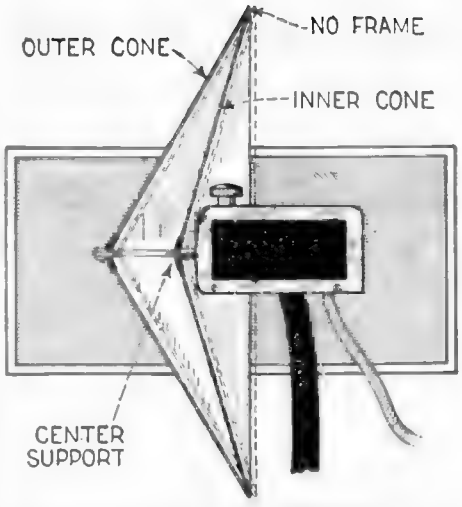
EVER since the S. S. *Republic*, in 1909, was saved by summoning assistance by radio, owners and operators of steamship lines have come to realize more and more that radio is one of the most important features of their service and that the very latest developments must be employed, if the best results are to be attained. Of course, there are radio laws today which specify certain equipment to be carried by ships, but such equipment merely covers the barest of necessities and does not provide for any particularly consistent service. If ships only carry the required amount of apparatus, they will often find themselves out of touch with land. If the latest types of vacuum tube transmitters and receivers are employed, there is no difficulty whatsoever in keeping in constant communication with land stations. The tube transmitters of today are far superior in all ways to the older type of spark installations that formerly were in universal use. With lower power and more compact apparatus, greater distances can be covered with tubes, than were even thought of of when spark transmission was used. Furthermore, with vacuum tubes, interference is reduced to a minimum inasmuch as this type of transmitter can be sharply tuned; a great contrast to the spark sets. Therefore, with tubes, consistent transmission at all times can usually be had without the operator having to wait his turn until interference clears up.



Above we see the operator of the S. S. Gripsholm's C.W. transmitter at the operating table. To his left is an efficient type of receiver designed to cover a wide band of wave-lengths.

IN response to the ever increasing demand for consistent radio communication, a powerful vacuum tube transmitter of the latest type has been installed on board the S. S. *Gripsholm*, a new electrically driven liner of the Swedish-American line. The photographs on this page give a very good idea of the completeness of the installation and the compact manner in which it is installed. A one-kilowatt vacuum tube is employed as an oscillator and two rectifier tubes are also used. The plate current supplied to the oscillator after it has passed through the required rectifier and filter system is actuated by a pressure of 12,000 volts. The installation is so arranged that the oscillator tube can be used either for C.W. (continuous wave) or radiophone transmission as may be desired. Passengers can communicate with other ships by phone just as easily as if they were using the telephones in their own homes. Then for commercial traffic, the necessary switches can be thrown and the entire installation used as a C.W. transmitter. Traffic is then handled from ship to shore and from ship to ship. Passengers avail themselves most frequently of this service, particularly business men who desire to keep in constant touch with their home offices. The transmission is so perfect and consistent that it has won the praise of many and the operators are elated over the working of the installation.

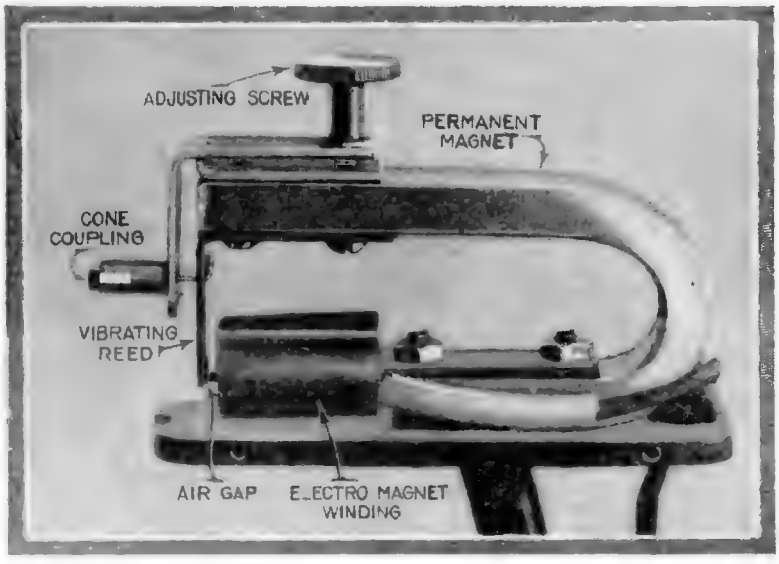
# The Latest in Cone Speakers




The above diagram shows the double cone construction and in exaggerated form, the motion which the cone shaped diaphragms take when vibrated by the ruggedly constructed element illustrated below.

A front view of this new cone speaker.

The above illustration shows a rear view of this new loud speaker employing two cones for setting up atmospheric vibrations. Note how the cones are not supported in any frame whereupon the large diaphragms are allowed to move freely without the damping effect of a supporting frame. The sole support of these diaphragms is the center rod by means of which they are attached to the shaft which in turn, is fastened to the vibrating reed. The advantages of the double cone construction are obvious when it is known that the audibility curve of a single cone is very erratic. Using two cones of different shapes as shown in the diagram in the top center of this page overcomes many such defects.



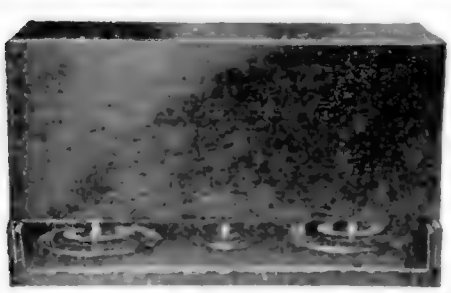

When two cones are used as the large diaphragms of a loud speaker, and they are of two different angles at their apexes, the theory of the operation is simply that when a note is sounded which one cone fails to reproduce satisfactorily, the other one usually will step into the breach and reproduce the note perfectly. That this is quite true is proven by the excellent operation of the type of double cone loud speaker shown. To the left is a photograph of the interior mechanism of the unit that operates the double free cones. Note the extreme simplicity of every part and the ruggedness of the entire assembly. The size of the air gap is controlled by the adjusting screw indicated.

*Photos courtesy Fitch Radio Co.*

## Novel Cabinet

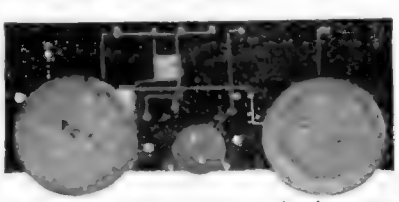
A NOVEL method of mounting radio instruments in an unusual cabinet is illustrated on this page. There is no vertical panel as is usual with radio sets. Instead, the panel is horizontal and the instruments are mounted as shown in the photograph in the lower left-hand corner and the drawing in the lower right. Then, if desired, a loud speaker with a specially designed horn could be placed in the rear of the cabinet and the opening for the horn could be cut at the top of the front cover. The various photographs here are only meant to serve as suggestions to constructors who may desire to make up a radio set that is a little out of the ordinary in design.

Aside from the unique method of placing the instruments, there are several advantages of this construction. One of them is the accessibility of the instruments and another is the ease of tuning. Rotary instruments do not have to be balanced inasmuch as the rotating parts have their axes perpendicular. In this way, bearings that are not used for connections can be loosened. —*Edward Rosewater.*

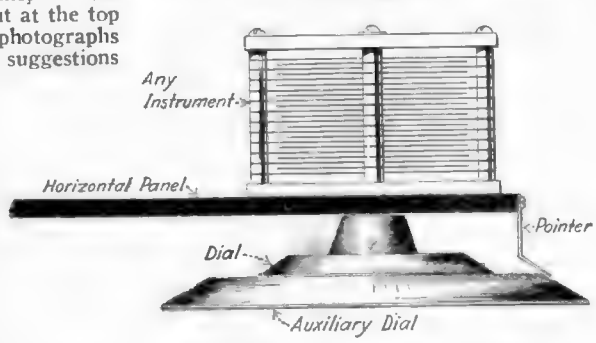


View of set with cabinet closed.

Front raised showing instrument layout.



Above: The bottom view of the instrument panel shows the wiring and the placement of controlling dials.




In this set, a standard dial is drilled all the way through and attached to the shaft, an auxiliary dial being placed as shown. This is not necessary if a larger dial can be obtained for the main one.

# Artists of the Microphone

## A Further Discussion of WRNY and Its Development

### By Charles D. Isaacson, Program Director WRNY

Charles Dana Gibson, the prominent illustrator, is the creator of the "Gibson Girl" and publisher of "Life." Mr. Gibson and his associates handle the Humor Department for WRNY.

CHARLES DANA GIBSON

A most interesting singer, Rose Laurent, is known as the "American Songstress." She sings at WRNY the works of the American composers. Her voice has been called perfect for radio.

ROSE LAURENT

Heading the Talking Machine and Radio Men, Inc., Irwin Kurtz directs one of the most popular features at WRNY, and will bring stars of the leading phonograph companies to WRNY.

IRWIN KURTZ

Star of the Radio Art Players, who produce the dramatic classics of the past for WRNY audiences. Shakespeare and Moliere will appear in their program, as well as Rostand, Wilde, Barrie and Shaw.

MADELAINE HUNT

BEATRICE JOY—you have seen her in the movies, no doubt—fascinating actress of the screen, came to WRNY. It was in the *Motion Picture Review*. We had announced her along with a number of other stars, directors and personages of the screen. When she came in, she said: "I—I—I—really wish you would excuse me, I cannot go on, I am nervous, I have never spoken to an air audience before." There was no doubt about it, no acting, she was frightened beyond words.

Finally, she consented to go into the studio and just look at the microphone, and then she heard her name mentioned and some things about herself, and she spoke. It was a lovely impromptu speech she made, one of the most felicitous I have heard in many a day. When she was through she jumped with joy, she had done it, she had made her first spoken appearance!

Now she cannot wait until she goes on again. One of her friends said: "But how do we know that anyone is hearing it?"

Then I remembered Election Night here at WRNY. We had been on the air from noontime until 7 o'clock, when we started to broadcast the election returns in the midst of a program of light opera music and many other features. We had loud speakers in every big reception room. Members of our staff were handling other returns from the telegraph lines. At 11 o'clock, the "Up and Down Broadway" feature began, and members of the cast of "Dearest Enemy" were heard, and authors, composers, members of the orchestra, chorus; and big hits from the show were put on the air.

At midnight we had permission to broadcast the first Indoor Golf Tournament direct from the Roosevelt. The biggest golf champs were to be there. Then we discovered that every available line that could be used for broadcasting from the Hendrik Hudson room where the tournament was to take place, was in use. What could be done? Last minute arrangements brought about this condition:

William S. Lynch, who is the popular music and sports editor of the station, placed himself in the Hendrik Hudson room at the telephone. At his side was Miss Hazel Crakow, with Sarazen, McFarlane, and others,

"Hello Jane," he says, and "Hello Phil," she answers, and then the two proceed with popular and concert numbers. Lillian Gordoni and Phil Elliott are "Jane and Phil."

Head of the New York State Knights of Columbus, including one-fifth of the total membership of the Knights of Columbus of America, Mr. Daniel Tobin, directs the Catholic Circle at WRNY.

DANIEL TOBIN

The director of the Women's Club Hour, Mrs. Edgar Cecil Melledge, prominent leader of women, heads the weekly symposium each Tuesday morning at 11.00 from WRNY.

MRS. EDGAR CECIL MELLEDGE

Eugene Frey is the "Lieder Singer." He will present the works of the immortal Germans in lieder songs; music of Schumann, Brahms, Schubert, etc. His period at WRNY will be a fortnightly adventure.

EUGENE FREY

Dr. Spaeth is author of the "Common Sense of Music," and the popular "Barber Shop Ballads." His hour at WRNY is a fortnightly feature.

DR. SIGMUND SPAETH

Ilonka and her kiddie dancers. Ilonka joins WRNY and will be heard every other week in actual dance demonstrations. Sensitive boards and other apparatus will enable the audience to hear and visualize the movements. Ilonka's full name is Ilonka Sheer. She is the youngest dance mistress, and the creator of all the dances which her pupils use. Ilonka will be starred in a Broadway production this season.

**THE SADRIAN TRIO**

The Misses Phillips and Miss Berley comprise the Sadrian Trio, which has been reviving the delights of the old-time musical comedies for those who remember them with a feeling akin to affection. In this repertoire has been comprised music of Gilbert and Sullivan, De Koven, Straus, Offenbach, Sousa, Victor Herbert and many others. The Sadrian Trio comes from Boston, and have had many club engagements.

DR. CHRISTIAN F. REISNER

Dr. Christian F. Reisner: Pastor of the Chelsea Methodist-Episcopal Church, and pastor-to-be of the new sky-scraper temple, appears regularly at WRNY on Sundays.

ordering them around as though they were amateurs. I put the microphone at my desk and as Lynchie telephoned up the reports, I repeated them into the microphone, and added such comments about the election, the station, and related and unrelated matters as I could summon to my tongue. There were moments when Lynchie was gathering information, and while waiting during one of these intervals for reports, I decided to find out if anyone *was* actually listening. On my desk are several telephones—Vanderbilt 7360, Vanderbilt 8662, Vanderbilt 9200 and Vanderbilt 10218. I spoke into the microphone and asked the listeners to let me know by any of these numbers if they liked what we were doing, or not.

The words were scarcely out of my mouth when the phone began to ring, so that the persons calling in could get a response from their telephone as well as their loud speaker. I would sandwich Lynchie's comments into the broadcasting along with all the calls from New York, Brooklyn, Long Island, New Jersey and Connecticut. I think this had gone on for about 15 minutes when the telephone supervisor, in great excitement, said: "Please, please, please beg the people to stop calling these lines. Every single office in New York and Brooklyn is clogged with hundreds of calls waiting for you. We

(*Continued on page 952*)

Tom Hill is the president of the American Society for the Promotion of Aviation, Inc., and brings all of the eminent aviators to WRNY to inform the public on this vital subject of interest to every American.

TOM HILL

PATRICK PIERCE

Patrick Pierce directs Roger Wolfe Kahn's orchestra at WRNY. It is a fine ensemble of eight gifted young musicians. Occasionally Mr. Kahn takes part himself — and he can play any instrument.

DR. SIEGFRIED BLOCK

Eminent Consulting Neurologist on the staff of leading hospitals of Manhattan and Brooklyn, Dr. Siegfried Block speaks on mental and health matters from WRNY.

SAMUEL POLONSKY

Samuel Polonsky: A pupil of Alexander Block, and later of Leopold Auer. He is now dividing his time between his concert work and teaching. He plays popular concert classics at WRNY.

Hetty Fithian Cattell: You know her as "The Birthday Lady." Every night she appears at WRNY in the feature "Whose Birthday Today?" Her talks bring out the mystic astrological and numerological meaning of the day. Has she read your name as yet?

HETTY FITHIAN CATTELL

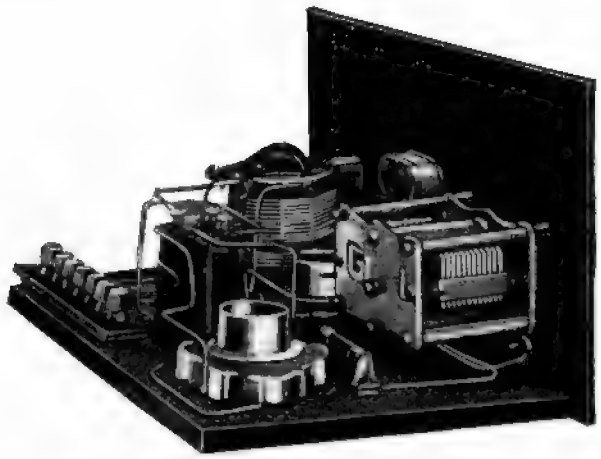
Ralph Christman: Asst. Musical Director at WRNY, and a capable official accompanist. He reads any music at sight.

RALPH CHRISTMAN

# The Radio Constructor

*Describing the Construction of a Short-Wave Regenerative Tuner*

By A. P. PECK



The photograph at the left shows practically all of the parts used in the construction of this short-wave three-circuit regenerative tuner. Any standard parts that may be at hand can be used in the construction of this set and excellent results may be expected if care is exercised in the building of the parts, in the assembly and in the wiring. Follow this compact layout if you want a mechanically small set.

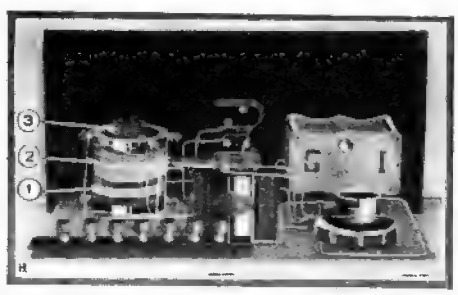
SINCE the publication of the article dealing with a short-wave transmitter in the October issue of SCIENCE AND INVENTION, we have had many requests from various readers who are desirous of constructing a short-wave tuner that will enable them to cover the 40- and 80-meter amateur bands without changing coils. Furthermore, a good many of our readers are cognizant of the fact that some broadcast stations are operating on the very short wave-lengths and they are desirous of tuning in on these programs so as to note the difference, if any, between short-wave and standard-wave broadcasting. In order to meet the many requests that have been sent to the writer, the radio receiving set shown in the photographs on this and the opposite page has been designed and built. Placed in actual operation in the writer's station at 3MO, the particular set under discussion did not quite cover the desired wave-length band. In fact, checked against a wavemeter, its range was from 40 to 120 meters. Obviously this is not exactly what is desired for short-wave work, inasmuch as it does not cover the complete 40-meter amateur band. Therefore, a .00025 mf. tuning condenser was substituted for the .00035 mf. shown in the accompanying photographs and the desired results were obtained. It was now found that the tuner would cover a band of from below 35 meters to 100 meters. The reason that no definite figure can be given for the lower end of the band is because of the fact that the wavemeter available at the time would only tune down to 35 meters. However, this set with a .00025 mf. condenser for tuning the secondary can be relied upon to do all of the work that anybody can possibly desire for a short-wave receiver tuning below 100 meters.

### LIST OF PARTS

1. 4-turn primary coil.
2. 12-turn secondary coil.
3. 14-turn tickler coil.
4. .00025 mf. variable condenser.
5. .00025 mf. fixed grid condenser.
6. Variable grid leak.
7. Detector tube.
8. Detector tube rheostat.
9. .001 mf. blocking condenser.
10. Audio-frequency transformer (see text).
11. Audio-frequency amplifying tube.
12. Fixed filament resistance.
13. Cord tip jacks.
14. Filament switch.

### TYPE OF SET

In designing the set a good many things were taken into consideration before the actual construction was undertaken. The writer realized that it is not always possible to make a perfectly mechanically balanced tickler coil, but, just the same, this type of construction was used in this particular set because, on the other hand, it costs little. A variocoupler can be constructed from odds and ends that are very easy to obtain and the cost of an instrument of this nature will undoubtedly be far less than that of a good variable condenser, such as would ordinarily be used in some sort of a capacity feed-back circuit. Therefore, the standard three-circuit regenerative type of receiver was adopted for this and another reason. This last reason was because the circuit is well known among broadcast listeners and most operators are quite familiar with its operation and general characteristics.




The view above was taken looking directly at the back of the short-wave tuner. Note handy terminal strip for connections.

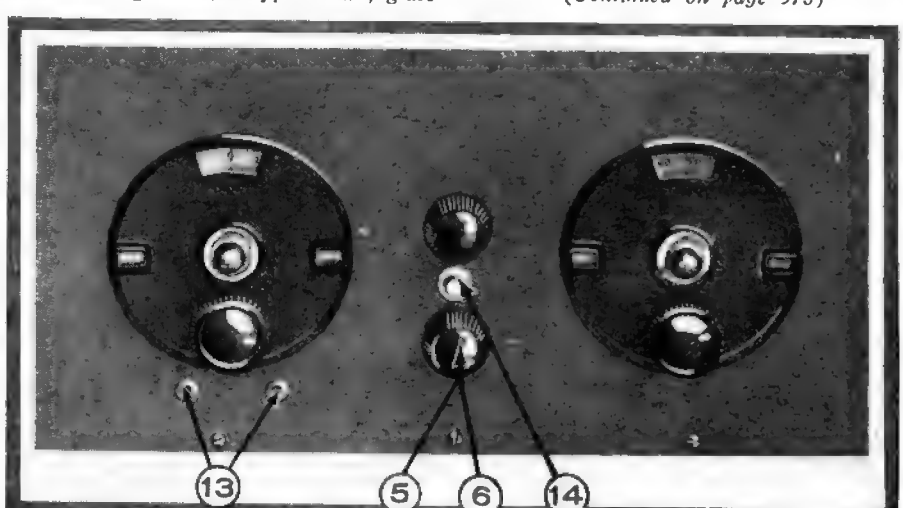
Let us first deal with the construction of the variocoupler. The one shown is of a standard manufactured type procurable on the market today, but if the reader desires to build his own, and he probably will, at least for an experiment, the following details are given: The stator is wound on a form 2¾ inches in diameter and at least 2¾ inches long. In the type shown, glass rods supported between bakelite ends are employed for supporting the wires, but any other type of low loss form, or, for that matter, any thin insulating tube can be used. If the latter is employed, it is advisable to cut away portions of it in longitudinal sections so that the amount of dielectric in the field of the coil will be reduced and, consequently, the losses will be lower. Two coils are wound on the stator, one constituting the primary or untuned antenna coil, 1, and the other being the secondary, 2. The first consists of four turns of wire and the second employs twelve turns. In the coupler illustrated, flat copper ribbon was employed and wound so tightly on the form that it could not move. However, the reader will probably want to use ordinary round copper wire, inasmuch as it is easier to obtain and, therefore, ordinary antenna wire can be pressed into service. Space each turn of wire about its own diameter from the next turn, preferably winding cord between each pair of turns, so that the successive turns cannot become short-circuited. Do not put any kind of "dope" or binding adhesive on the windings, as this tends to increase losses tremendously, particularly when working at the high frequencies. The tickler coil, 3, of this tuner unit is wound on a form 1½ inches in diameter and consists of fourteen turns of No. 22 D.C.C. wire. Glass rods are also used on the rotor form of the instrument illustrated, but here again, any type of insulating tube can be substituted. A suitable shaft and mounting bracket is provided for rotating the tickler and for fastening the entire unit to the panel.

### TUNING CONDENSER

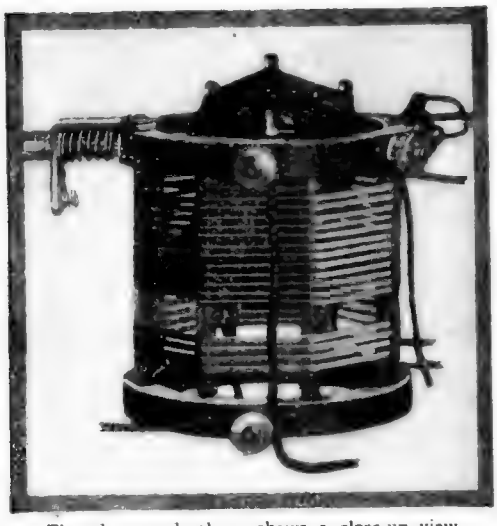
The other instrument of the tuning section of this set is a variable condenser, 4. Use a .00025 mf. size, and if you wish to obtain the very latest in tuning, use a straight-line frequency condenser. By doing this, the tuning on the 80-meter amateur band, which is not quite as sharp as the lower one, will be found quite satisfactory, whereas, when tuning around 40 meters, the stations will be separated more than they would otherwise be, if a straight-line capacity instrument was used.

In order to simplify the control of this set somewhat, a fixed resistance, 12, capable of controlling the audio frequency amplifying tube filament was placed in the filament circuit. By using this little instrument, another rheostat becomes unnecessary. However, in the detector circuit it is very advis-

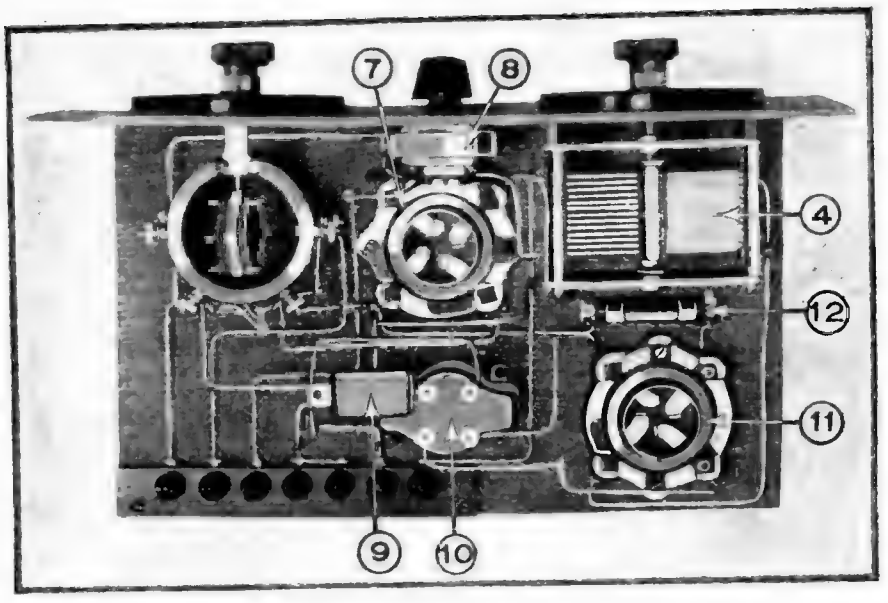
(*Continued on page* 973)



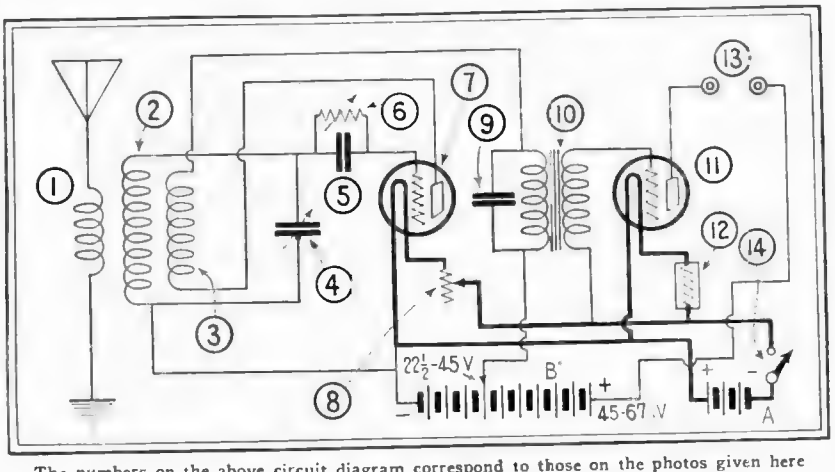

The panel view of this set gives an excellent idea of the neat and compact layout that has been employed. The numbers on this and the other photographs in this article correspond with those in the list of parts and on the diagrams on the opposite page.



The photograph above shows a close-up view of the coupler used. Note the glass rod supports and the ribbon winding.



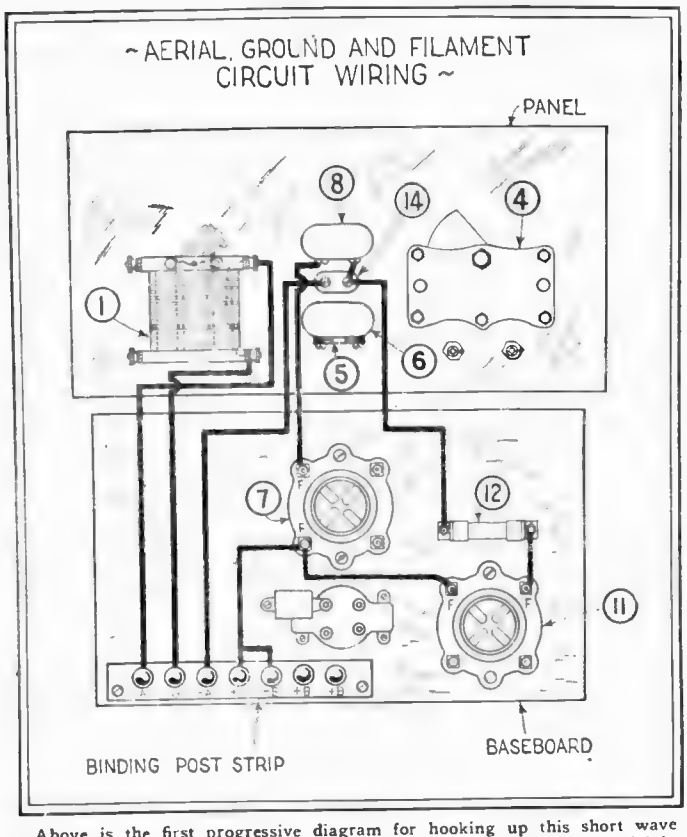

The circuit diagram at the right shows all the connections of the various instruments used in the set illustrated in the upper right-hand corner, on the opposite page and described in the text. This set, when properly constructed and using a .00025 mf. variable tuning condenser connected across the secondary of a coupler constructed as described in the article and illustrated above, will amply cover the two amateur bands, familiarly known as the 40 and 80-meter bands. The range should be approximately 30 to 90 meters, with, of course, some leeway on each side of the figures given. If it is not desired to purchase a coupler such as the one illustrated, a home-made one can be readily constructed at a small cost. All of the necessary winding data will be found in the text.



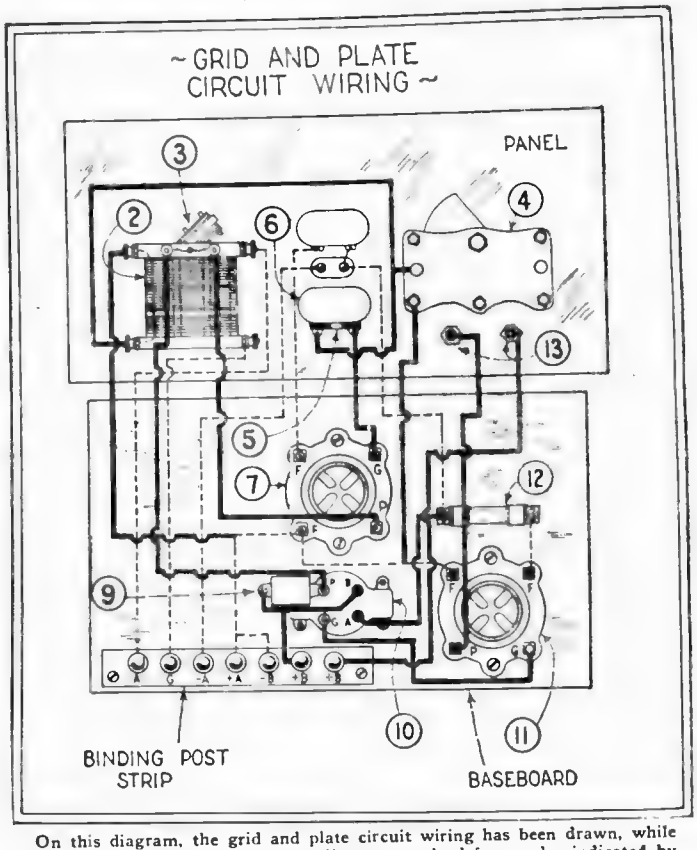

The numbers on the above circuit diagram correspond to those on the photos given here and the progressive wiring diagrams below. The values are given on the opposite page.

In the photograph directly above, practically all of the details of the layout of this simple short wave tuner may be seen. If this arrangement of instruments is followed, the leads can all be made comparatively short. Remember that if the special 1,000-cycle transformer mentioned in the text is employed, a .0005 mf. fixed condenser should be shunted across the secondary of it. This is not shown in our drawings. If a variable condenser is used in place of this fixed one, the best operating point of the transformer can be changed.

*Photos courtesy General Instrument Co., Bruno Radio Corp., Alen-Bradley Co., Electrical Research Laboratories, Inc., Radiall Co., Radio Specialty Co., and Martin-Copeland Co.*




Above is the first progressive diagram for hooking up this short wave tuner and on it the aerial, the ground and the filament circuits are plainly shown. Following this, you cannot go wrong.




On this diagram, the grid and plate circuit wiring has been drawn, while those connections shown in the diagram at the left are also indicated by dotted lines.

# More About "B" Eliminators

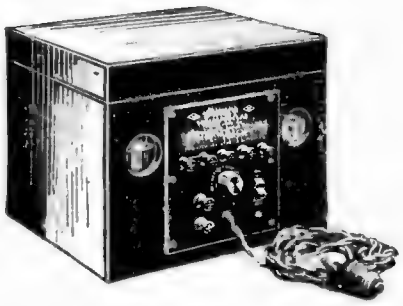
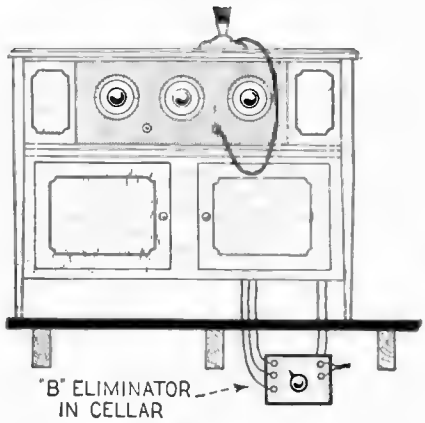
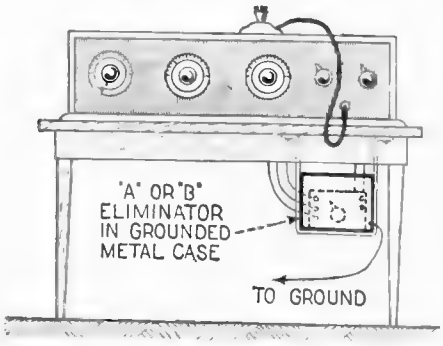
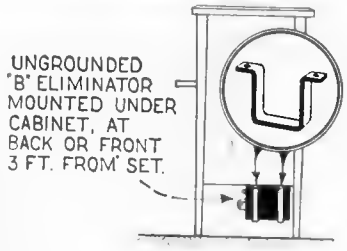


Photo above shows a new type of electrolytic battery eliminator recently placed on the market, while the one below shows the same eliminator with the back opened, revealing the rectifier and filter.

*Photos courtesy Philadelphia Storage Battery Co.*

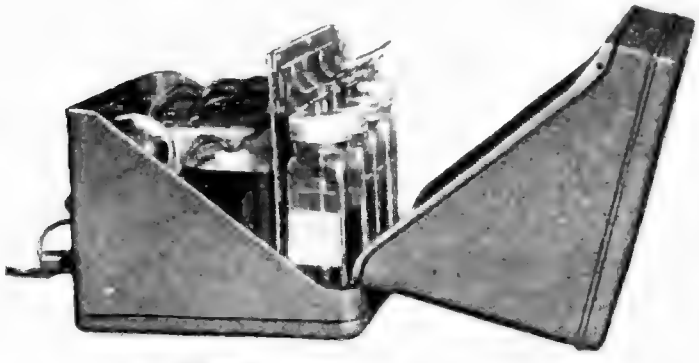


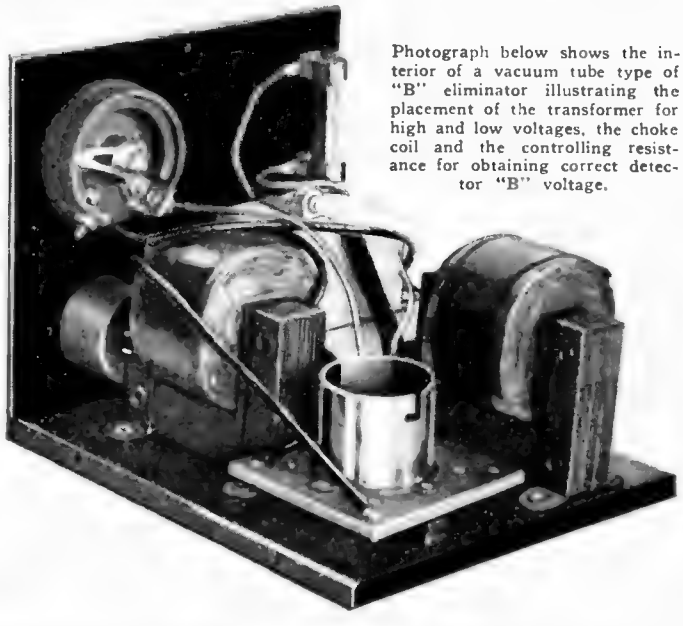

The drawings above give some hints regarding the use of "A" and "B" battery eliminators in connection with radio sets. If the eliminator is not shielded and grounded as in the upper right-hand illustration, it should be placed at some distance from the set. This is shown at the left above and immediately above at the right. An ungrounded eliminator should be at least 3 feet from the set.

—H. W. S.



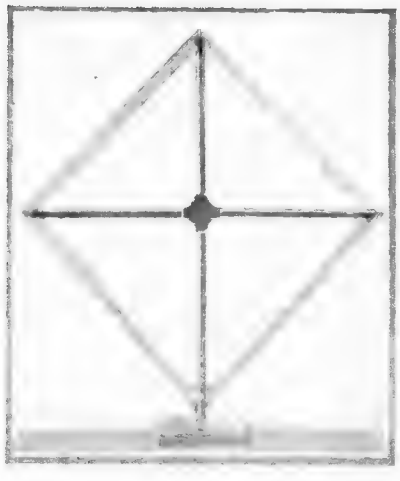
While the electrolytic rectifier has some advantages in that it has practically no upkeep cost, still there are many good tube rectifiers used as "B" eliminators and one of them is illustrated at the left and right. As with practically all other instruments of this nature, a voltage control for the detector is employed. The tube is fed by a transformer and a suitable filter system of choke coils and condensers is employed.

*Photo courtesy Chas. Freshman Co., Inc.*



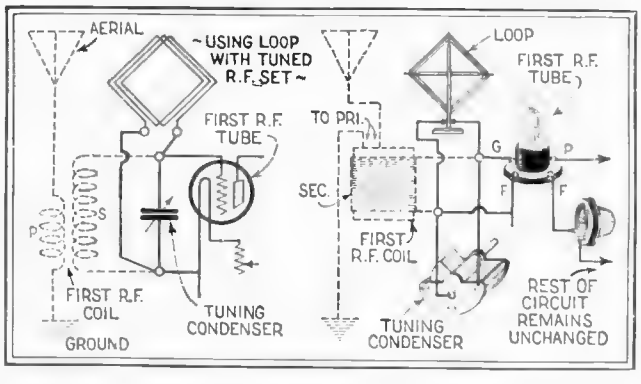
Photograph below shows the interior of a vacuum tube type of "B" eliminator illustrating the placement of the transformer for high and low voltages, the choke coil and the controlling resistance for obtaining correct detector "B" voltage.

# New Folding Loop



The constants of this new loop as furnished by the manufacturers are as follows: Self inductance, .00019 henrys; distributed capacity, 17.38 micro-microfarads; natural wave-length, 108 meters; resistance at 1,000,000 cycles, 8 ohms; wave band with .0005 mf. condenser, 180 to 600 meters.

A new type of folding loop in which the turns are wound in a novel banked formation is shown open at the left and closed below.



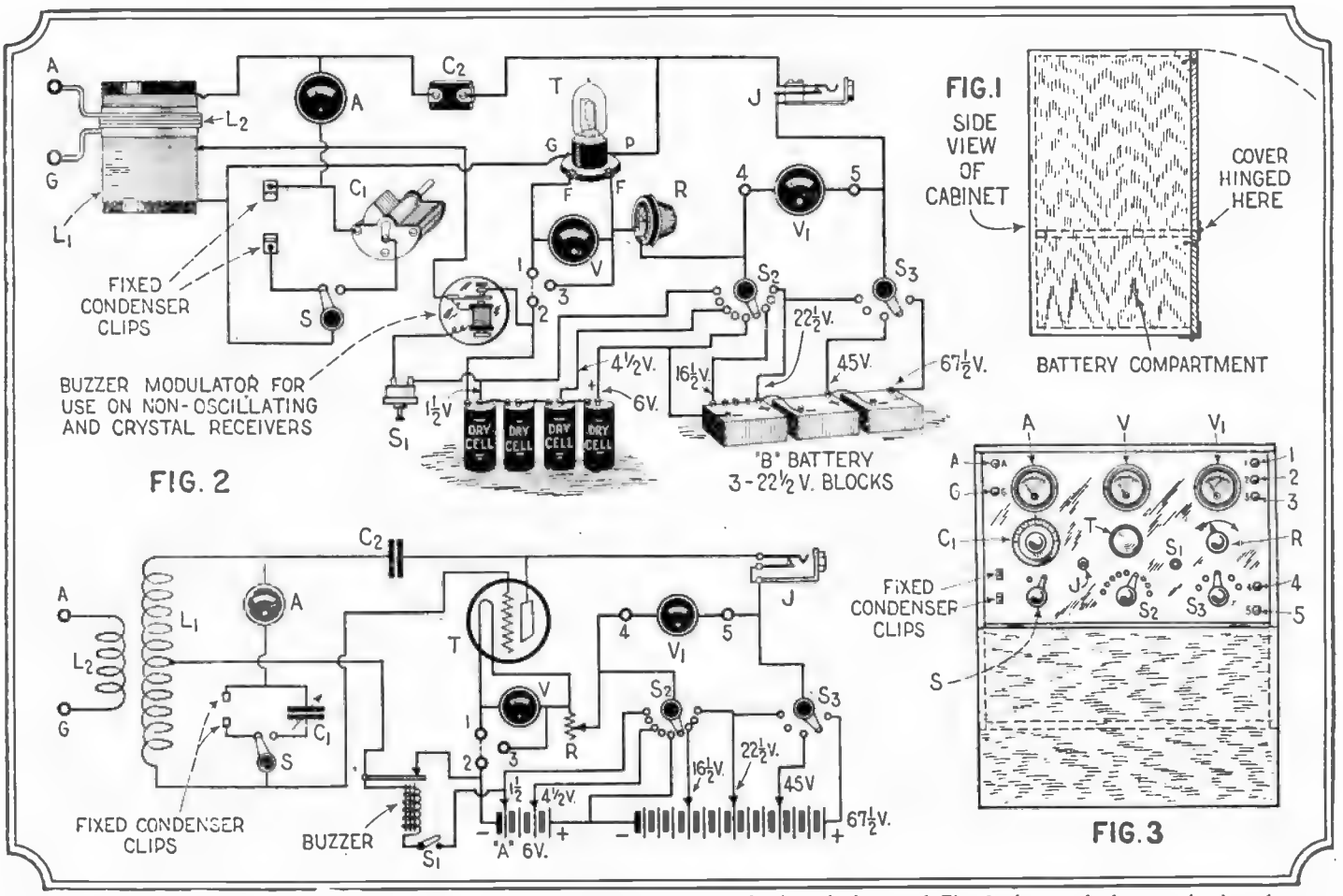

A well-made loop can be used with practically any type of radio receiving set that employs radio frequency amplification. A good many reflex sets work very well with a loop. Neutrodynes can be employed if the circuit shown above is followed. This same circuit applies to all types of tuned R.F. receivers. It can be seen that the loop merely replaces the secondary of the R.F. coil.

*Photo courtesy Radio Appliance Laboratory.*

# A Portable Radio Laboratory

## Detailed Directions for Constructing a Complete Laboratory Type of Oscillator and Tube Tester That Has Many Uses

By RAYMOND HERCHERT




**The various drawings above detail the construction and the circuit used in hooking up the instruments employed in this portable radio laboratory. Fig. 1 shows the case, Fig. 2, the complete circuit in both picture and schematic form and Fig. 3, the panel layout, showing the location of the various meters, switches and binding posts. Follow Fig. 3 for general arrangement, adapting your instruments to it.**

EVERYONE would like to have some convenient method of testing out various parts of circuits, pieces of apparatus and vacuum tubes. Furthermore, the man who makes a business, either regularly or occasionally of repairing various types of radio receiving sets, also finds that an installation of this sort would be most handy. Therefore, in the illustrations above, and the paragraphs here, we are giving complete detailed directions for the construction of a portable radio laboratory with which many different tests may be made and which is constructed of standard apparatus mounted in a suitcase.

Before describing the various things that can be done with this layout of apparatus, let us first go into the details of the construction. A small suitcase is obtained and upon the size of this the exact mechanical layout of the rest of the apparatus will depend. The suitcase should preferably be reconstructed as shown in our Fig. 1 herewith and it is obvious from this, that a casing made completely of wood is far superior to any other material. When using such a case, the cover is removed and carefully cut crosswise as indicated. Then a shelf is installed within the main part of the suitcase so that its upper edge is at a level with the saw cut. In this way, a cabinet in the lower or smaller part of the suitcase is formed in which the various necessary batteries can be placed. Here they will be out of the way, yet readily accessible for changing. Hinges are placed on the cover so that the same can be opened in two parts. Opening the upper section discloses the instrument panel of this portable laboratory, whereas opening the entire case completely, the batteries are disclosed.

The circuit diagram of this radio laboratory is given in Fig. 2 and in Fig. 3 is shown a suggested layout for the various instruments used. It will be noted that this layout is only to be followed generally and no definite dimensions are given because of variations in the sizes of parts and of casings.

Referring again to Fig. 2, in which the instruments designated by letters are also indicated by the same letters in Fig. 3, we find that the following constants are necessary. L1 consists of 50 turns of No. 24 D.C.C. wire, wound on a three inch tube and tapped at the 25th turn, this tap going to the buzzer circuit. L2 is 4 turns of wire, wound directly over L1 and separated from L1 by means of two or three layers of wax paper. C1 is a tuning condenser and should have a capacity of .001 mf. When you purchase this instrument, buy a good one and at the same time obtain a calibrated capacity curve. This should be carefully preserved for future reference. A is a thermocouple type of radio frequency meter, reading from zero to 50 milliamperes. V is a 0 to 25 volt D.C. volt-meter. V1 is a 0 to 100 volt-meter. R is a 50-ohm rheostat. T is the vacuum tube socket. C2 is a .00025 mf. fixed condenser of some good standard type. J is a closed single circuit jack. A single-pole single-throw switch is indicated by S1 and this may be of the standard push-pull filament type. S2 is a multi-point switch for varying the voltage of the "A" battery and also for cutting in additional voltage to be used for tube reactivating. A switch for varying the voltage of the "B" battery is indicated by S3. The varions binding posts are shown in both Figs. 2 and 3 and are indicated by numbers. These are referred to in the description of how to use the installation.

To test any aerial and ground for reception purposes and determine whether or not such an installation will give results when connected to a standard radio receiving set, connect them to the posts marked A and G. Turn on the filament of the vacuum tube, giving it its proper voltage and upon turning the condenser, C1, beat notes of various stations will be heard, providing, of course, that the aerial and ground are good.

As a radio frequency tube tester, insert the tube to be tested in the socket and adjust to proper filament voltage. This is indicated by the volt-meter V. Put the tuning condenser at the highest setting and the radio frequency meter, A, will show a reading. Tubes giving the same reading on this meter for constant filament voltage, plate voltage and tuning condenser setting will match quite well

(*Continued on page* 965)

# Power Amplification from Your Ford

## Amplifying Transformers and Impedance Coils Made From Ford Coils

By RALPH H. SLATER

DID you notice, when you drove your Henry down to the shop this morning, that it was not the Rollicking Rollo it used to be?

Your Leaping Lena may be shiftless, but it really isn't lazy. Its four tired wheels are simply slowing up with age (age even slowed up Gibbons, and it will get Greb soon).

In this golden era of advanced science your pebble-dodger's sluggishness should cause you no uneasiness. It can probably be remedied by a gland transplantation in the old scatter-bolt.

Drop into the nearest garage and buy four new spark coils (the glands in question) for Lizzie and you'll be surprised at the little puddle-hopper's improved form, but, of course, what is more important, you will have the four old coils for power transformers for your amplifier.

I have suggested one way of obtaining four coils from a Baby Lincoln, but if you can beg, borrow, purloin or obtain under any pretenses (false or otherwise) the four coils required, they will serve just as nicely.

Kidding aside, this amplifier may come from a powerless twin two, but it will give the straight eight results that we are after.

The first step in the proceedings is the dissection of the coils, all four of them. Be careful not to damage the condensers, as we can use these, too.

When you have the four coils and condensers cleaned off, which is some job, I will admit, you had better turn in for the night. It's surprising how late it has become, isn't it. If it is Saturday night, and the wife doesn't object to your staying up for an all-night session, you can take the primaries from all the coils by removing the wire from the inner coils, and while you're at it, wind the wire on one of those empty spools that have been lying in your junk box for the last six months. The wire is fairly heavy and can be used to wire the amplifier, if you wish.

Now we will get a knife from the kitchen (chuck it out in the alley when you are through, because, "out of sight, out of mind"), cover the blade with grease, heat it and proceed to cut the coils apart. Clean the pitch off the ends and now we have eight coils where four grew before.

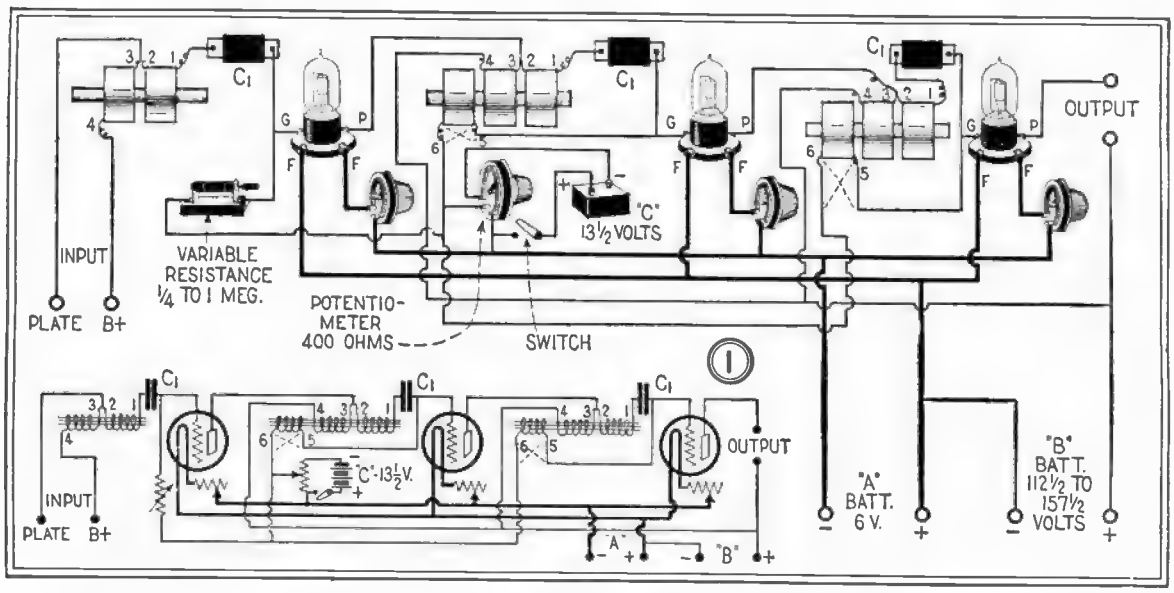
With the knife point, separate the paper layers at the inside of the coils where they are connected together, pull out a turn of wire and scrape off the enamel gently. The fine wire won't stand any rough stuff.

Test the coils for continuity with a dry cell and phones. If the coil under test is all right, you will hear a click.

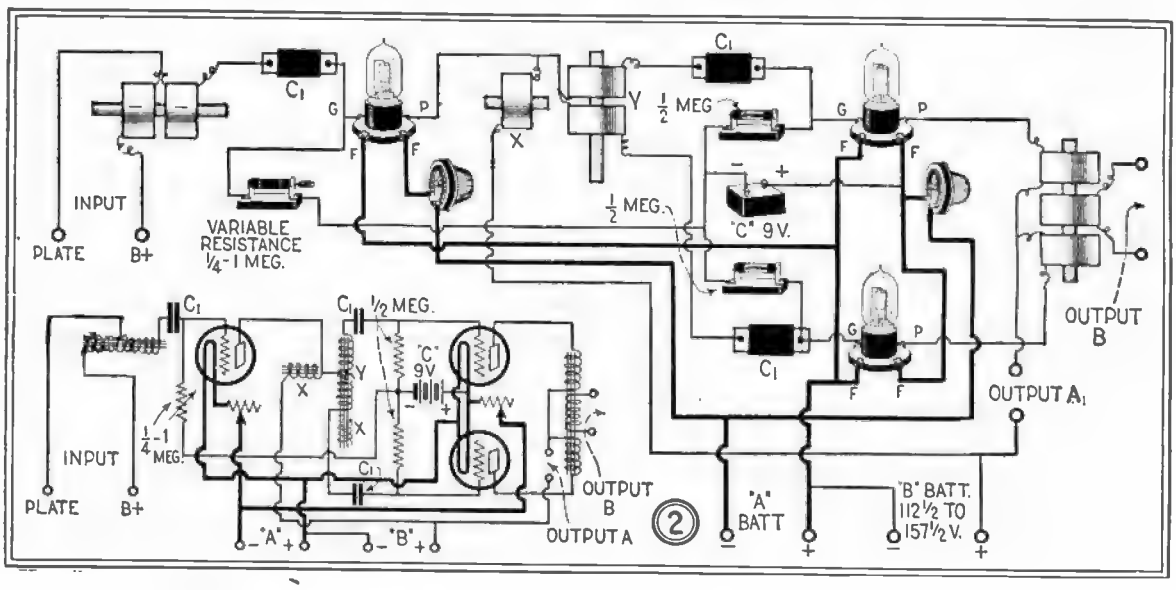
Now we will heat up the soldering iron and solder flexible wire leads on the coils. Don't try to solder with a torch, as the fine wire will melt as soon as the flame touches it. Secure the leads to the coils with sealing wax, or use some of the pitch that was in the coil boxes. This prevents breakage due to any twisting action that may take place.

The cores come next. Slit the wax paper cover with a knife and hit it a sharp rap on the table. (Don't do it on the dining room table; this is apt to cause a strain on family relations the next morning.) The bundles of wire will fall apart and the eight cores will make quite a pile of wires, but here comes the sad part for the Scotch; we will have to get a dime's worth of stovepipe wire to go with it.

Cut some heavy wax or wrapping paper into two strips $5 \times 6$ inches and one $3\frac{1}{4} \times 6$ inches. Roll the strips loosely into two tubes $1 \times 5$ inches and one $3\frac{1}{4} \times 1$ inch. On the 5-inch rolls slip three coils spaced about $\frac{1}{8}$ of an inch apart and on the $3\frac{1}{4}$-inch roll place the remaining two coils. Fill the centers solid with the wire from the original cores. If the wire is packed in tightly you will find use for that stovepipe




In the novel type of amplifier shown in pictorial and schematic form at the left the first stage is coupled to the detector through a split impedance coil and the second and third stages are coupled together by means of three-coil transformers, two of the coils giving the effect of an impedance coil, and the third being placed in the grid circuit to produce a further amplification effect. This is a rather unusual connection and one that leaves room for much interesting experimental work. The blocking condensers C1 are those taken from Ford coils and serve to prevent the high plate voltage from reaching the grid of the succeeding vacuum tube.




Using the secondaries of Ford coils, an interesting type of push-pull amplifier can be constructed as shown in the diagrams at the right. A biasing voltage is applied to the grids of the three amplifier tubes by means of a 9 volt "C" battery connected to them through resistances. It is preferable to have the resistance in the grid circuit of the first amplifier tube variable so that the greatest efficiency can be obtained. For that matter, in experimental work it would probably be of value to have the other two grid resistances variable, so that the circuit can be more thoroughly studied and tested.

wire in the last transformer, and will be ready for the hook-up.

There are several circuits that can be used with these transformers and a great deal of experimental work can be done with them. The diagrams shown are self-explanatory and I am not going to burden you with a lot of stuff about this wire going here and that wire going somewhere else.

Diagram No. 1 shows the coils used as auto-transformers with the third coils on the second and third transformers to act as grid-to-filament paths. The coils have a comparatively low resistance, which greatly improves quality, but would reduce volume except for the fact that they are in inductive relation with the transformers proper and act as pick-up coils, which compensates for the loss that would result otherwise from a low grid-to-filament resistance.

When rightly connected, the third coil assists. Opposite connections result in a blocking action. For this reason, connections 5 and 6 must be reversed in your trials to determine which is right.

The "C" battery voltage is quite critical. It should be rather high and should be controlled by a potentiometer of about 400 ohms. Place a switch in the "C" battery circuit as shown. The condensers marked C1 in all diagrams are the ones removed from the original coil boxes.

Diagram No. 2 comprises a stage of auto-transformer coupled amplification and a second stage that is a variation of the push-pull circuit that I believe to be original. The coil X should be removed from the end of one of the three-coil transformers and should be filled with iron wire or filings. The X coil is then placed in non-inductive relation to Y, as shown in the diagram.

Diagram No. 3 is simply an auto-transformer stage and a standard push-pull stage that has nothing in particular to recommend it except simplicity of construction and operation.

In summing up the three circuits, No. 1 has the greatest over-all amplification and if you intend to use the power amplifier alone in connection with crystal or detector tube without preceding amplification, No. 1 will prove the most satisfactory. No. 2 is capable of the greatest volume output of the three when preceded by one or two stages of ordinary amplification. To secure maximum results from No. 2 a fairly strong input is necessary. No. 2 is simple to construct and operate, gives good quality and volume at output A, but has not the power obtainable from No. 2.

Diagram No. 4 is still in the process of development and is shown only as an experiment. It is also a form of push-pull and I think it, too, is original with myself. It delivers volume about equal to that given by No. 2, but the quality of reproduction is not so good. The circuit operates in the erratic manner of the temperamental motor vehicle whose spark coils we are using.

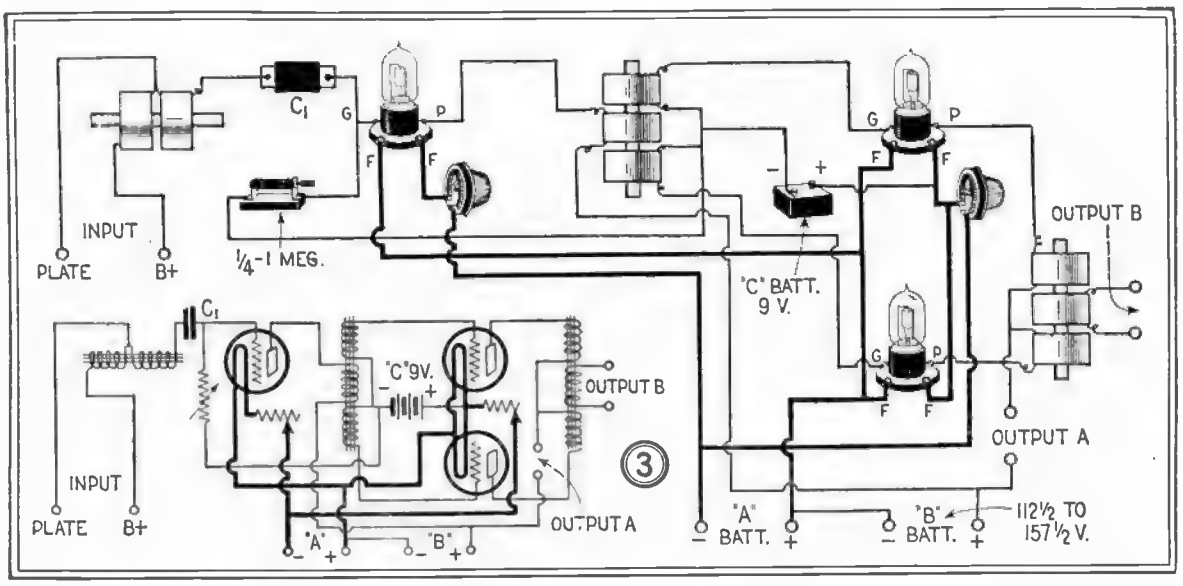
Resistance R2 should be quite low. I use a variable grid leak with several heavy pencil marks across the resistor strip. A potentiometer is used across the "C" battery for best results. As in the other circuits, output A is the most satisfactory. All of the circuits shown require a high "B" battery voltage. From 100 to 150 volts are necessary with 201As. If DV5s or other power tubes are used, they should carry at least their maximum rated plate voltage. Dry cell tubes do not give satisfactory results and are advised against. The rated voltage of 201As is 135, but I have several that are still standing up well, after being loaded with 150 volts for nearly a year.

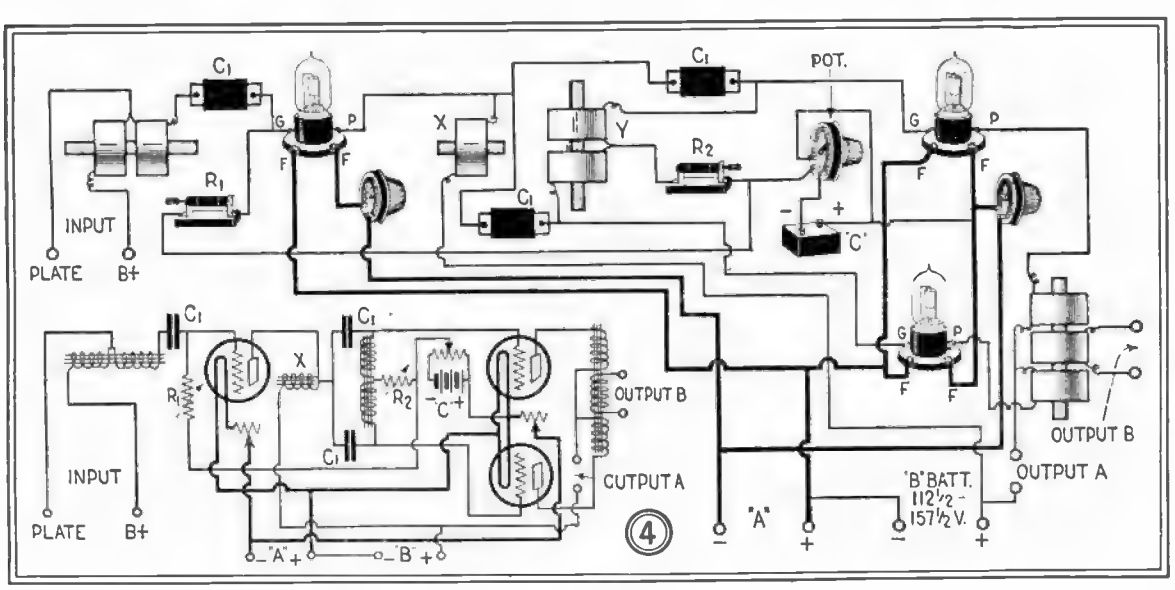
Closed cores for the transformers would increase the volume somewhat, but the construction as given will handle all the power a good loud speakeer will carry and a lot more than some of the not so good variety will stand.

Any of the circuits shown will amplify signals with the maximum power that the tubes used are capable of handling. There is a limit, contrary to general opinion, to the output of a tube, beyond which it is impossible to obtain results.

After the last difficulty has been ironed out and you have listened to louder radio music than you thought possible (incidentally receiving complaints from neighbors a block away), then, brother, take off your hat to one of the greatest benefactors to mankind in the world—the only automobile that has consistently contributed to the development of radio, the only motor-driven vehicle made in 1926 with an 1898 ignition system. *Selah.*

In a still different type of push-pull amplifier using home-made choke coils, the grid bias is applied from a 9 volt "C" battery through the impedance coils to the grids of the last two amplifier tubes, and through a variable resistance to the grid of the first tube. In this circuit there is no need for grid blocking condensers in series with the grids of the push-pull tubes. This is because a transformer effect, rather than an impedance coupled one, is employed in connecting the first amplifier to the last two tubes. See text for details relative to the use of the two sets of output terminals marked A and B.




The author of this article has done considerable experimental work with home-made amplifiers and his latest is shown in the diagrams at the left. As stated in the text, this circuit is meant only for the experimenter, inasmuch as it is erratic in action and cannot be depended upon to function smoothly at all times. The author is still experimenting on it and we may expect to hear of some more definite results at a future date. In the meantime, the circuit is offered so that anyone who desires to do so may work on it and try to make some improvements of his own. For the present, "that's all there is, there isn't any more."

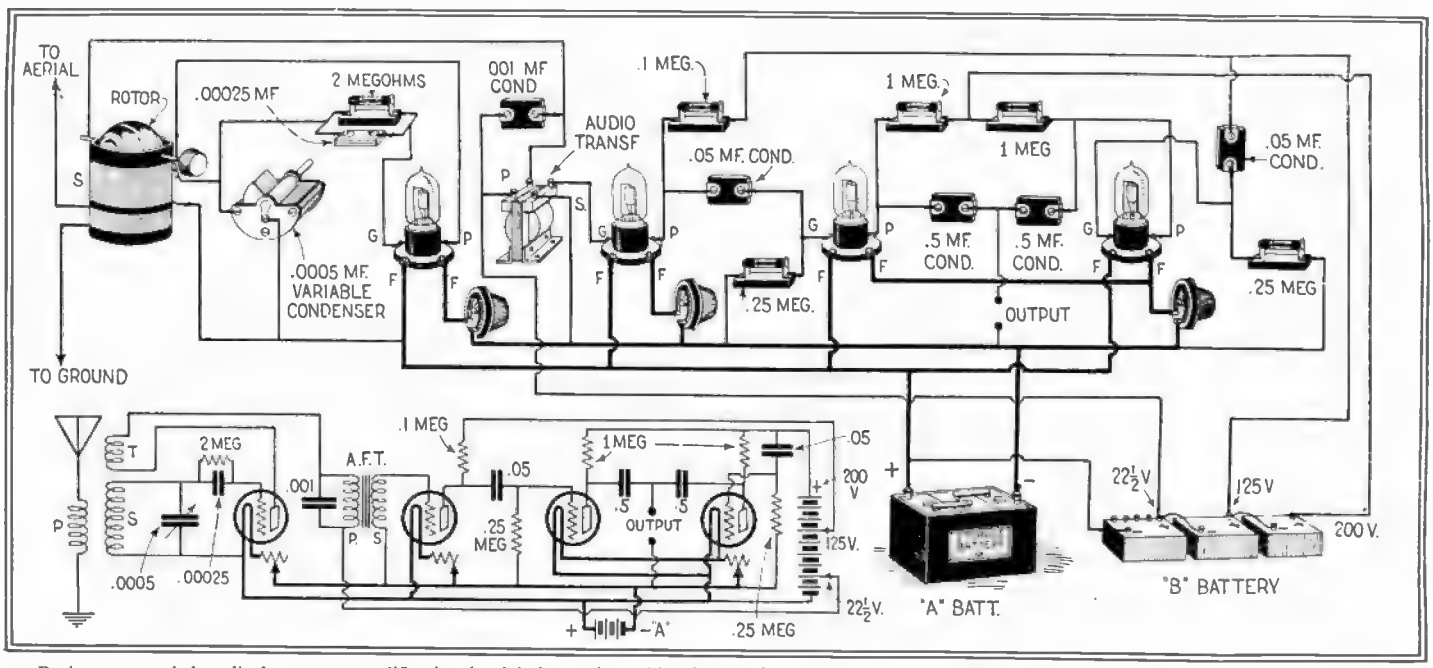
# RADIO ORACLE

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 50c is made for all questions where a personal answer is desired.

### PUSH-PULL RESISTANCE COUPLED AMPLIFIER

(443) Q. 1. Alexander Stuart, New York City, has been experimenting with push-pull amplifiers employing resistance coupling, but does not seem to get any particular results. He asks us to publish what we consider to be the best circuit for this work.

A. 1. The requested circuit diagram will be found here. We show an ordinary three-circuit coupler used for tuning and one stage of audio-frequency amplification, transformer coupled, between the detector and the first resistance-coupled amplifier. All of the values for the resistances and condensers in the push-pull circuit are given on the drawing. It is preferable to use power tubes in the last two sockets and employ up to 425 volts to the plates. This will give great volume with little distortion.




Resistance-coupled audio-frequency amplification is claiming quite a bit of attention in the radio world today, and above we show a very unusual circuit employing resistances for coupling vacuum tubes together in a push-pull audio-frequency amplifier circuit. Since all of the values are given in the schematic and pictorial circuits, the interested experimenter should find no trouble in trying out this circuit.

### RADIO PHONE AND CODE RECEPTION

(444) Q. 1. Winston Clay, Kansas City, Mo., asks whether or not the same type of radio receiving set can be used for receiving radio broadcasting and also receiving code.

A. 1. There is no difference between a receiving set which will receive broadcasting and one which will receive code signals.

### S.L.F. CONDENSERS

(445) Q. 1. Frank Allen, Atlanta, Ga., asks: If I changed my present type of straight-line capacity condenser for one having a straight-line frequency curve, can I expect any greater selectivity from my receiving set? The set under discussion is of the three-circuit type.

A. 1. Generally speaking, you cannot expect to increase the selectivity of an inherently broad tuning set by the mere addition or substitution of an S.L.F. condenser for an S.L.C. type. The only thing that an S.L.F. condenser will do for you will be to spread out the shorter wave-length stations so that they can be more easily separated. It will change the relative positions of stations on the dial as compared to an S.L.C. condenser, and it will, furthermore, tend to bunch the high-wave stations closer together than they were formerly. At this point it is found that an S.L.F. condenser will be a detriment in a broad-tuning set because the higher power stations on the high waves will cause more interference with each other, when an S.L.F. condenser is used. However, for average sets, an S.L.F. condenser is an advantage, inasmuch as it allows better reception of short wave-length stations.

### LOCATION

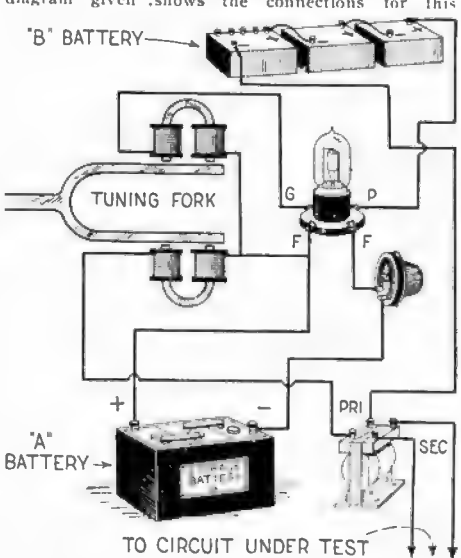
(446) Q. 1. Wm. F. Shollenberger, Lebanon, Pa., says that in his particular locality few of the receiving sets can tune in Philadelphia stations. He asks whether this trouble can be banished and also wants us to recommend some type of radio receiving set to him.

A. 1. Very possibly the fact that few if any of the people in your town can tune in Philadelphia is because of local conditions. Such conditions cannot be changed. Since you say that you know little about radio, we would suggest that you purchase a complete set ready made. An excellent type is what is known as the three-circuit tuner with a detector and two stages of audio frequency amplification. Such a set can be used on an ordinary outside aerial that any of your friends can show you how to erect and it will give excellent results.

### CONSTANT FREQUENCY

(447) Q. 1. J. K. Windell, Charleston, W. Va., asks whether or not it is possible to use the characteristics of a vacuum tube to maintain a tuning fork in vibration at a constant frequency.

A. 1. This is entirely possible and the circuit diagram given shows the connections for this




A system for maintaining a constant frequency, using a tuning fork and a vacuum tube, is shown above.

work. This system is patented and is used extensively in electrical testing work. The tuning fork is driven by means of two electromagnets, A and B, which may be taken from ordinary 75-ohm receivers in order to set up this circuit for experimental use. This circuit is not self-starting, but the tuning fork must be vibrated first in order to set up currents in the vacuum tube circuit. By doing this, the movement of the upper prong induces a current in the grid coil. This, of course, starts up a momentary plate current which causes the magnet in the plate circuit to attract the other prong. This action takes place many times per second, the exact number depending upon the natural frequency of the tuning fork. In the circuit shown, an ordinary audio-frequency transformer is employed so that instruments under test or circuits to be tested can be connected into the circuit without disturbing the constants of the vacuum tube and tuning fork circuit itself.

It is interesting to note that several amateurs have experimented considerably with this system of maintaining a constant frequency for use in transmission. The results have been very gratifying.

### SUPER-HETERODYNES

(448) Q. 1. M. David, Johannesburg, S. Africa, says that he has noticed circuits of several Super-Heterodyne receivers in various publications and that they all appear to be a little different from each other. He asks if the one appearing in the April, 1925, issue of this magazine is correct, as it, too, appears to be somewhat different from others.

A. 1. There are several different types of Super-Heterodyne hook-ups and in most of them there are small differences in the connections of the oscillator. The one that you mention as appearing in SCIENCE AND INVENTION is correct and will give good results.

Q. 2. How should I wind intermediate frequency transformer?

A. 2. The winding of intermediate frequency transformers is a rather difficult and tedious process. Furthermore, the results obtained are seldomly satisfactory, due to inaccuracies in windings. We would advise you to purchase a set of these coils ready made.

### SHORT-WAVE PHONE

(449) Q. 1. J. S. Brooks, Keysville, Va., asks for details on building a short-wave radiophone transmitter operating below 100 meters.

A. 1. We regret to say that we cannot supply you with the information you desire. It is against the radio laws of the United States to operate a radiophone transmitter on any other wave-length than between 170 and 180 meters. Furthermore, do not forget that in order to operate any transmitter whatsoever, you must have both an operator's and station license.

### LACK OF VOLUME

(450) Q. 1. Lewis Doty, Cleveland, Okla., is using a receiving set of the Reinartz type from which he does not get as much volume as he desires. He is only using 67½ volts on the amplifiers and desires to know how the volume can be increased.

A. 1. Increase the "B" battery potential to 90 volts. An extra stage of audio frequency amplification can be added. Inasmuch as you employ UV-199 tubes, you cannot expect great volume.

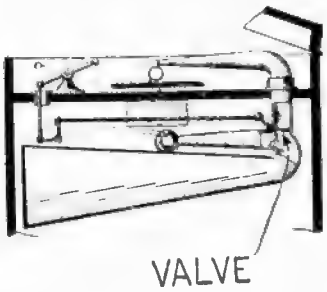
Q. 2. Can a loop be used with this set?

A. 2. It is advisable to use an aerial and ground instead of a loop which at best will work only on local stations.

# LATEST PATENTS

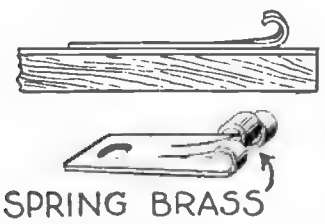
## RADIO-PHONOGRAPH COMBINATION

No. 1,555,340, issued to Morris Victorsohn, describes the construction of a horn having two sound chambers feeding into it. One is connected to




a phonograph reproducer and the other to a radio loud speaker unit. Either reproducer can be opened into the main chamber of the horn by manipulating the flap-valve, controlled by a convenient lever. The essential details can be seen in the above drawing.

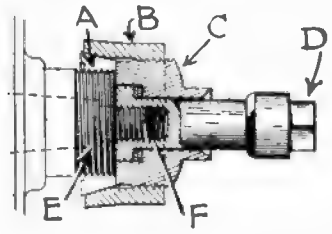
## BINDING POST




No. 1,544,301, issued to A. P. Fahnestock, protects a new type of extremely simple binding post shown above. Stamped from a single piece of spring brass, it grips a wire tightly. The central one of three hooked prongs is bent upward slightly; to insert a wire, it is pressed down so that all three line up. The wire is inserted and held firmly by spring action.

## WHEEL PULLER

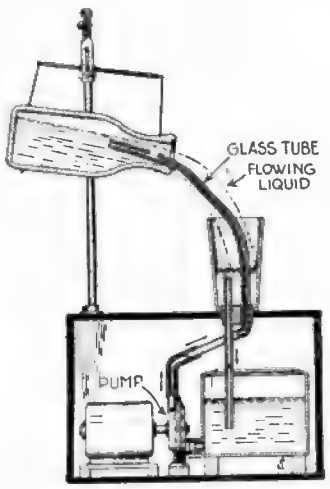
No. 1,550,802, issued to Floyd Hampton and John P. Umhoefer, describes the wheel puller shown. Ring A screws on the hub, sleeve B slips over it, part D screws on axle F and by applying a wrench to the square head D, the wheel is forcibly removed from its axle without in the




least damaging the threads of either the hub or the axle. E indicates threaded part of hub. This wheel puller is said to be far superior to the usual type inasmuch as it places no strain on the spokes nor can it mar the finish of any part of the wheel.

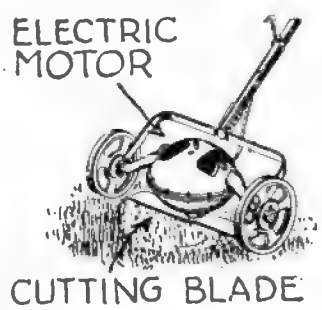
## WINDOW DISPLAY

No. 1,536,188, issued to Earl A. Brown, shows how easy it is to obtain a patent upon any device, if one tries hard enough. This continuously flowing window display, illustrated below, has been in use for many years, but here we find a patent just issued on it. The details are given. A reservoir of liquid and motor-driven pump are located in the base. A colored liquid is used and is pumped up through the glass tube into the bottle from whence it flows outward into the colored glass con-




tainer, the flow of liquid concealing the glass tube. The action is continuous until the motor is stopped and the effect is one of an ever-flowing bottle of liquid. The bottle is hung by threads to complete the illusion.

## LAWN MOWER

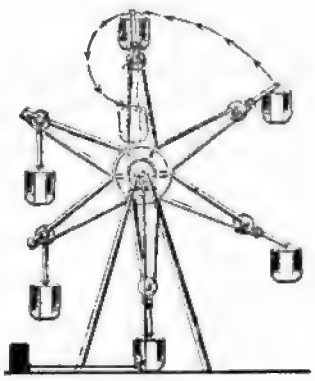



No. 1,558,465, issued to Herbert H. Dahl, covers an electrically-driven lawn mower having a revolving blade, sharpened so as to effectively cut grass. The essential parts of the device can be seen in the above illustration. The electric motor is supplied with current by means of a flexible cable connected at its other end to a suitable source of supply. This type of lawn mower, if properly constructed, should provide a means whereby grass can be cut very evenly and uniformly throughout a large area. The motor is suitably supported so that the blade will always be at the same distance above the ground.

## SHOWER BATH

No. 1,544,706, issued to Nannie L. Wallen, describes a type of shower bath device that can be attached to any tub and receives its supply of water from the regular faucets. The upright of the device is clamped firmly to the tub, as shown, by means of a clamp. By suitably designing the spray nozzles, practically all of the water delivered can be kept within the confines of the tub and, if necessary, an ordinary shower bath curtain can be provided to prevent splashing of water on nearby objects. The patented device is so designed that the spray nozzles can be tilted at any desired angle merely by loosening a conveniently located wing nut. The device is interesting mainly because of its simplicity.

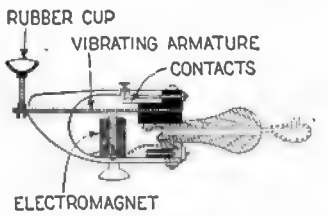
## FERRIS WHEEL



No. 1,555,488, issued to Irwin J. Siebert, covers the design of a Ferris wheel for amusement parks that certainly should provide very nearly the ultimate in thrills. As can be seen in the above illustration, the car hangs vertically from a locked arm. As it ascends, it eventually reaches the uppermost position, whereupon a gravity-operated catch releases and allows the car to swing forward and downward as indicated by the dotted lines and the arrows. When it reaches the bottom of its swing, the entire wheel still continues in its rotation until it again reaches the bottom and the car-carrying arm once more locks in a position in line with one of the main arms of the Ferris wheel.

## VIBRATOR

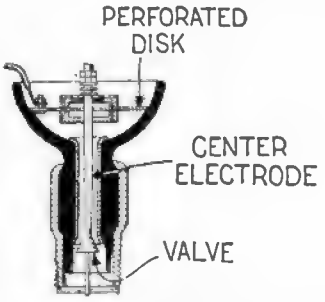
No. 1,510,138, issued to George de Cairos-Rego, protects the very simple electrically operated massage vibrator illustrated here. All of the essential details are shown. A com-




paratively heavy vibrating armature is so arranged with two contact points that the circuit is periodically broken and closed. A suitable handle is provided and a suction cup is fastened to the protruding end of the vibrating armature. The electromagnet is energized from a suitable source of current.

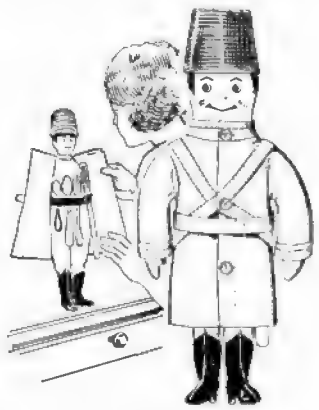
## SPARK PLUG

No. 1,509,163, issued to Einar Minge, described a self-cleaning spark plug




through which the cylinders can also be primed for easy starting. Air is drawn into the cylinders through the perforated disk and the valve. Priming fluid is introduced in the same way. The spring shown controls the amount of air entering.

## SILVERWARE HOLDER



No. 1,544,267, issued to Craig D. Munson, is illustrated above. It is a decorative holder for silverware, formed in the shape of a toy doll. By unbuttoning and opening the overcoat, the silverware concealed under it is revealed.

# Scientific Humor

### THE SOLUTION

STUDENT: "Professor, what is partheno-genesis?"

PROFESSOR: "That is very simple, my boy. Partheno-genesis is the exact opposite of Adam and Eve-olution."—*S. Liebling.*

### CORRECT

"Papa," said the small son, "what do they mean by college bred? Is it different from any other kind of bread?"

"My son," replied the father, "it is a four-year loaf."—*Henry Millington.*

### GREATLY ATTACHED TO IT

FIRST LADY: "We just got a $100 radio set and the electrician came in and attached it."

SECOND LADY: "That's nothing. We got a $500 one and the sheriff came in and attached it."—*Earl Bennett,* Reporter No. 20604.

### EN-TWIN-ED

"We get twin bed-time stories on our radio."

"Yes?"

"Yes. We get two stories from different stations at the same time."—*Raymond LeBlanc.*

### WAS SHE RAILROADED?

A young lady not familiar with the switching language of railroad men happened to be walking near the depot where a freight train was being made up. One of the brakemen shouted: "Jump on her when she comes by, run her down by the mill and cut her in two and bring the head end up by the depot."

"Help! Murder!" screamed the young lady, as she fainted and fell into the arms of a man."—*Joe T. Fabian.*

### DRY HUMOR

PROFESSOR: "Ernest, what is dust?"

ERNEST (after much thought): "Mud with the juice squeezed out."—*Elsie Koester.*

### WATT HE RAN 'OHM FOR

PHYSICS TEACHER (to class): "Can anyone tell me what electicity is like?"

BRIGHT STUDENT: "Like a coward."

TEACHER: "Why?"

STUDENT: "Because they both choose the path of least resistance."—*T. E. Kangas.*

### "TWINKLE—TWINKLE, LITTLE STAR"

Scintillate, scintillate, globule vivific,
Fain would I fathom thy nature specific,
Loftily posed 'mid ether capacious,
Strongly resembling a gem carbonaceous.
—*Marie Phelps.*

## FIRST PRIZE $3.00

### HOT-AIR

Radio is great stuff. The speakers don't have to worry about halitosis, pyorrhea, baldness or a clean-shaven face.—*Joseph Mersan.*

### NEEDLESS TO SAY

LITTLE BOY (to Dad): "Say, Dad, the teacher in physics asked us to use auto-transformer in a sentence. Can you think up one for me?"

DAD: "Yes. Your Ma spends too much money and I think we auto-transformer (ought to transform her).—*W. A. McLain,* Reporter No. 27568.

*WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. We cannot return unaccepted jokes. Please do not enclose return postage.*

*All jokes published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to tie for the prize, then the sum of three dollars in cash will be paid to each one.*

### WE HOPE YOU DID

A professor of biology in a large university was notorious far and wide for one failing, an absent mind. One day he entered his class-room and said: "Now, gentlemen, I have in this parcel a very fine specimen of a dissected frog—very interesting." He opened the wrappers and disclosed to view a few sandwiches and some fruit. The professor seemed transfixed, then he said: "But—good gracious—surely I ate my lunch."—*Adric G. Boulter.*

### IT'S A TOSS-UP

CONCERT SINGER: "It's very tedious singing for the radio. One misses the bouquets."

BRUTAL FRIEND: "And the eggs."—*T. B. Marsden, Jr.*

### GAS-O-LINE AGAINST A POST

TONY: "Have you zeen ze man zat poured benzine to put out ze fire?"

MIKE: "No. Why?"

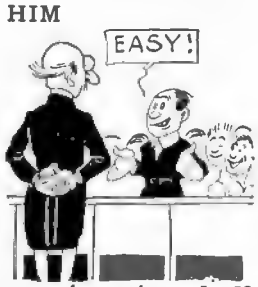
TONY: "Well, he ain't ben-zine since."—*George Chin.*

### RAIN IS NEVER MIST WHEN IT'S DEW

1ST ONE: "Put the barrel under the rain spout to get some soft water so we can wash."

2ND ONE: "How can it be soft when its raining hard?"—*Charles Field.*

### SOMEONE'S BEEN STRINGING HIM




PROFESSOR: "Now tell me how you could ascertain the height of the Woolworth building with a pocket barometer."

BRIGHT STUDENT: "Lower it from the top with a string and measure the string.—*J. H. Ferguson.*

### PAGE MAJOR CEMENT

MR. FORD: "Do you use toothpaste?"

MR. FORDSON: "Gracious, no! None of my teeth are loose!"—*I. Bercovitch,* Reporter No. 27278.

### JUST LISTEN TO THE BED TICK

JONES: "Did you hear about the murder?"

BROWN: "No."

JONES: "The paper hanger hung a border and when they tried to investigate they found it was only a rumor."—*Elmond Kenyon.*

### LET'S FIRE HER

MOTHER (who has aspirations for her daughter's radio voice): "Do you ever think, Professor, that my daughter will be able to do anything with her voice?"

PROFESSOR: "Well, madam, it ought to come in handy in case of a fire."—*James Washington Grimes.*

### FIT—FITTER—FITTEST

TOM (to Dick): "Yesterday I saw a cat who had a fit and it died. I saw another one who had two fits and it died, and I saw a third cat who had three fits but which didn't die."

DICK: "How do you account for that?"

TOM: "Survival of the fittest."—*Douglas Thompson.*

### O.S.-A.R.

SCHOOLGIRL: "Our geometry teacher doesn't use correct English, does he?"

SECOND SCHOOLGIRL: "Why?"

FIRST SCHOOLGIRL: "He says 'pie are square,' and should say 'pie is round'."—*Alvin Mayhan.*

# THE ORACLE

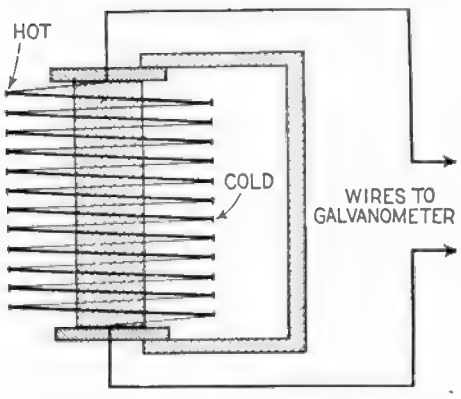
The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculations, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

## THERMOPILE

(1987) Q. 1. James L. Kay, Rochester, N. Y., asks: What is a thermopile?

A. 1. A thermopile is a series of thermocouples joined together after the manner shown in the diagram in this column and it may be connected to some sort of a galvanometer or ammeter. A thermocouple consists of two strips of different kinds of metal which, when heated at the point where they are joined together will genrate a very slight electrical current. Connecting several of them together in series enables the operator to generate a higher voltage. In the case




A schematic diagram of a standard thermopile is shown above. One series of junctions are hot and the other cold, whereupon current is generated.

of a thermopile such as that shown, one set of junctions is heated while the other set of junctions is kept at a lower temperature.

## BRITISH THERMAL UNITS

(1988) Q. 1. J. R. Edwards, Worthington, Pa., asks: What is a British thermal unit and how is it applied to the determination of the efficiency of an internal combustion engine?

A. 1. The British thermal unit, or B.T.U., as it is usually written, is a unit of heat that can easily be applied to the work you mention. The heat produced by combustion is expressed in B.T.U.s and the horsepower, being a known measurable quantity, is also expressed in the same terms. The amount of heat produced in B.T.U.s is then placed in an equation as equalling 100 per cent. From this, the percentage of efficiency of the engine can be determined in the following manner: Let us assume the following simple figures. 1,000 B.T.U.s of heat are produced by the combustion, but the power produced by the engine is equal to only 500 B.T.U.s. Then, by dividing 1,000 B.T.U.s into 100 per cent., we find one B.T.U. equal to one-tenth of 1 per cent. Five hundred B.T.U.s are then equal to 50 per cent. efficiency in the particular case under discussion. In all calculations of this nature, one horsepower is equal to 42.416+ B.T.U.s per minute.

## PASTE

(1989) Q. 1. A. Yust, San Francisco, Calif., asks for a formula for making up a good quality of paste that can be kept for a considerable period of time.

A. 1. We are giving you herewith a formula for a paste. It is very similar to one of a well-known paste which gives excellent results.

Mix a quantity of a good grade of rye flour with cold water into a thick paste, being sure to stir sufficiently to remove all the lumps. Add boiling water, stirring continually until thoroughly mixed and of about the right consistency or slightly thinner. To three quarts of this mixture add one-fourth of a pound of light brown sugar and one-eighth of an ounce of corrosive sublimate. The latter should be dissolved in a small quantity of hot water. When the mixture has cooled, a small quantity of oil of lavender or oil of cloves may be added. This paste will keep for a long time.

## CLAY

(1990) Q. 1. J. B. Barclay, Shanghai, China, asks: How can I make a clay mixture that can be used for lining forges?

A. 1. Claying mixture for forges: Twenty parts fire clay, 20 parts cast-iron turnings, 1 part common salt, ½ part sal ammoniac; all by measure.

The materials should be thoroughly mixed dry and then wet down to the consistency of common mortar, constantly stirring the mass as the wetting proceeds. A rough mold shaped to fit the opening, a trowel and a few minutes' time are all that are needed to complete the successful claying of the forge. This mixture dries hard and when glazed by fire will last.

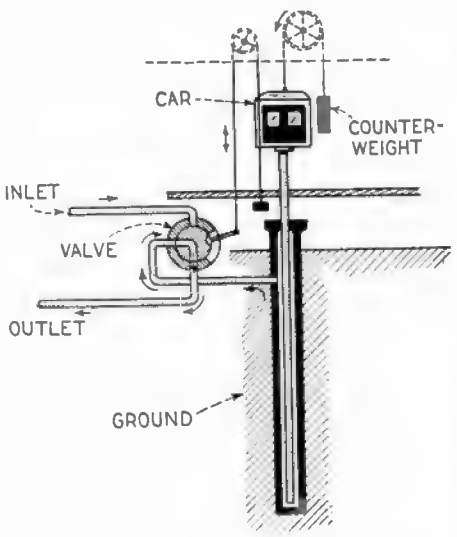
Q. 2. How is a good modeling clay made?

A. 2. Plastic modeling clay: A permanently plastic clay can be obtained by first mixing it with glycerine, turpentine or similar bodies, and then adding vaseline or petroleum residues rich in vaseline. The proportion of clay to the vaseline varies according to the desired consistency of the product, the admixture of vaseline varying from 10 to 50 per cent. The hardness of the material decreases with an increase with the amount of vaseline. By the use of different varieties of clay and the suitable choice of admixtures, the plasticity, as well as the color of the mass, may be varied.

## HYDRAULIC ELEVATOR

(1991) Q. 1. James Brody, Kansas City, Mo., asks how a hydraulic elevator operates.

A. 1. This device takes advantage of the fact that pressure in liquids is transmitted equally in all directions through the liquid. The diagram in this column shows a cross-sectional view of a simple hydraulic elevator. The valve controlling water under pressure is manipulated from the car. When it is turned so as to admit water into the pipe sunk in the ground, the liquid flows in under pressure and forces the piston upward. When the



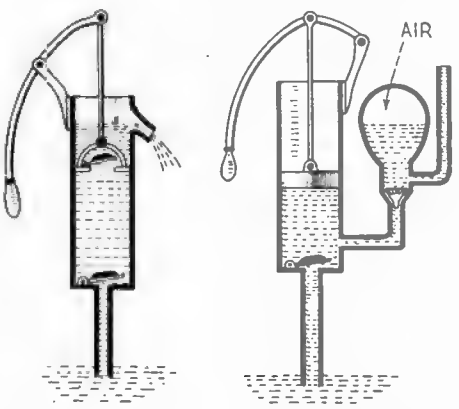

This simplified drawing shows the essential parts required for the operation of a hydraulic elevator.

valve is reversed, the water flows outward, due to the weight of the car. The installation of hydraulic elevators is one of the marvels of present-day engineering. Witness some extremely tall buildings employing these elevators wherein a shaft may be driven into the ground to a depth equal to the height of the building, or a telescoping system may be used. It must be perfectly straight and true, as must also be the piston or rod fitting into the shaft. The reader must realize that the diagram shown here is much simplified, as it does not indicate the various safety devices and supports that are employed in actual practice.

## PUMPS

(1992) Q. 1. Maurice Shelby, El Dorado, Kansas, asks us to detail the difference between a force pump and a lift pump.

A. 1. The drawing in this column will illustrate this difference. It will be noted that with the force pump shown, a fairly constant flow of water can be obtained, due to the air chamber shown. A valve is employed at the base of this chamber to prevent the water from flowing backwards into the pump. In the lift pump, two flap valves are used. When the plunger is drawn upward, water is drawn into the cylinder through




The difference between lift-pumps and force-pumps is shown above and is described in the text.

the bottom valve. When the plunger is forced downward, the bottom valve closes and that in the plunger opens. When the plunger is at the bottom of its stroke, there is a quantity of water above it and when it is drawn upwards, the valve in the plunger closes and the water above it is lifted and flows out of the nozzle. In the case of the force pump, water is drawn into the cylinder in the same way as in the lift pump, but when the plunger or piston starts downward, the water is forced out of a tube at the base of the cylinder, the flap valve closing at the same time.

## PICTURE TRANSFER

(1993) Q. 1. S. A. Stevens, Long Beach, Calif., asks how positive and negative photographs can be transferred from paper and film respectively.

A. 1. It will be almost impossible for you to transfer positive prints to glass, unless you merely mean to paste it thereon. In this case, ordinary paste may be used.

In the case of negatives, this is easily done. Immerse the negative in a formaldehyde solution until the emulsion has become almost insoluble and impermeable. Then it is placed in a solution of sodium bicarbonate until the gelatin has absorbed a sufficient quantity of it. When the negative is immersed in weak hydrochloric acid, carbon dioxide is liberated, and the little bubbles of gas which lodge themselves between the emulsion and the film cause a separation of the two, so that the emulsion may be stripped off. After having hardened it with formaldehyde, it is a lengthy process to get it saturated with sodium bicarbonate. It is advisable to use a combined bath of 1 part of bicarbonate, 3 of 40 per cent. formaldehyde and 20 of water; its tanning action is enhanced by the alkaline reaction, and two operations are superseded by one. After 10 minutes' soaking, the surface must be wiped and dried. A sharp knife is then used to cut all around the emulsion a slight distance from the edge, and when this is done, the negative is put into a 5 per cent. solution of hydrochloric acid, when the film will probably float off unaided; but, if necessary, may be assisted by gently raising one corner. The film may be then floated onto a clean glass sheet, removed from the solution and allowed to dry.

## WOOD POLISHES

(1994) Q. 1. T. N. Cottese, New Brunswick, N. J., asks: Can you give me some complete detailed information for polishing maple?

A. 1. We are giving you herewith some information relative to the polishing of maple.

In finishing hard wood with a wax polish the wood is first coated with a "filler," which is omitted in the case of soft wood.

The polish is the same as for soft wood. The simplest method of applying wax is by a heated iron, scraping off the surplus, and then rubbing with a cloth. It is evident that this method is especially laborious; and for that reason a solution or paste made of the wax is desirable. It may be dissolved rather freely in turpentine spirit.

The following recipes give varnish-like polishes;

1. Dissolve 15 parts of shellac and 15 parts of sandarac in 180 parts of spirit of wine. Of this liquid put some on a ball of cloth waste and cover with white linen moistened with raw linseed oil. The wood to be polished is rubbed with this in a circular motion. When the wood has absorbed sufficient polish a little more of the spirit of wine is added to the polish, and the rubbing is continued. The polished articles are said to sustain no damage by water, nor show spots or cracks.

2. Orange shellac, 3 parts; sandarac, 1 part; dissolve in 30 parts of alcohol. For mahogany add a little dragon's blood.

3. Fifteen parts of oil of turpentine, dyed with anchusine, or undyed, and 4 parts of ground yellow wax are stirred into a uniform mass by heating on a water bath.

4. Melt 1 part of white wax on a water bath, and add 8 parts of petroleum. The mixture is applied hot. The petroleum evaporates and leaves behind a thin layer of wax, which is subsequently rubbed out lightly with a dry cloth.

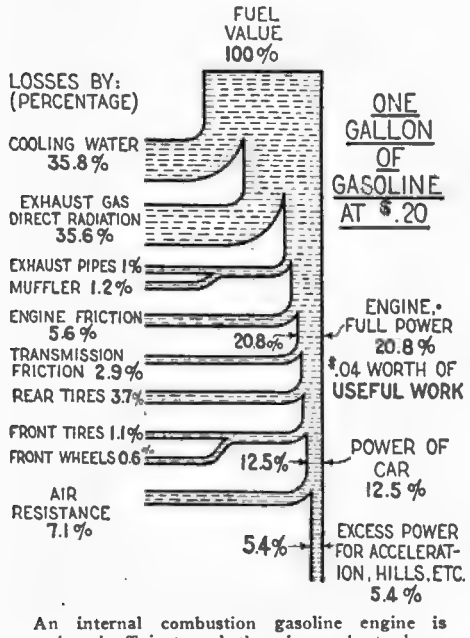
5. Yellow wax .....25 parts
Yellow laundry soap ..... 6 parts
Glue .....12 parts
Soad ash .....25 parts
Water, a sufficient quantity.

Dissolve the soda in 400 parts of water, add the wax, and boil down to 250 parts, then add the soap. Dissolve the glue in 100 parts of hot water, and mix the whole with the saponified wax.

6. This is water-proof. Put into a stoppered bottle 1 pint alcohol; 2 ounces gum benzoin; ¼ ounce gum sandarac, and ¼ ounce gum anime. Put the bottle in a heated sand bath or in hot water till the solids are dissolved, then strain the solution, and add ¼ gill best clear poppy oil. Shake well and the polish is ready for use.

7. A white polish for wood is made as follows:
White lac .....1½ pounds
Powdered borax ..... 1 ounce
Alcohol ..... 3 pints

The lac should be thoroughly dried, especially if it has been kept under water, and in any case, after being crushed, it should be left in a warm place for a few hours, in order to remove every trace of moisture. The crushed lac and borax are then added to the alcohol, and the mixture is stirred frequently until solution is effected, after which the polish should be strained through muslin.




An internal combustion gasoline engine is rather inefficient and the above chart shows just where losses occur.

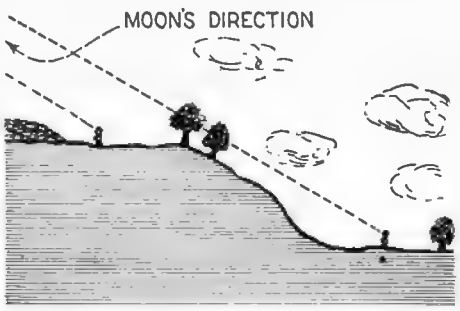
## ENGINE EFFICIENCY

(1995) Q. 1. Fred Burns, South Hamilton, Mass., says that he has been told that an internal combustion gasoline engine is very inefficient and would like to know the reasons for this.

A. 1. The power available for driving an automobile as furnished by a gasoline engine is about 12.5% of the full fuel value of the gasoline. In these columns we show an illustration indicating why this is so. Various loss-factors are found in an internal combustion engine and these are all listed here and the percentage of loss for which they are responsible is shown.

## SIZE OF MOON

( ) Q. 1. Robert F. Olsen, Indianapolis, Ind., raises the old question regarding the apparent difference in size of the moon when viewed at the horizon and at the zenith. He asks our opinion upon the reason for this apparent change in size.




Many observers have noticed that the moon when viewed near the horizon seems to be larger than when viewed at the zenith. The above diagram and the text in this column put forth the reason for this optical illusion.

A. 1. Some of the noted difference may be due to the varying amounts of atmosphere through which the light rays from the moon must pass before they reach the eye. At the horizon, this blanket of air is thicker than at the zenith but in our opinion, this is not the only fact goverung this peculiar optical phenomenon. We believe that the reason for the moon appearing larger on the horizon is because of the fact that we subconsciously compare it with nearby objects, whereas at the zenith our eye sees nothing else to distract it when looking directly at the moon. A verification of this latter theory may be had in a very striking manner, providing topographical conditions allow it, if the following procedure is carried out. Select a location with a hillside such as that illustrated here and view the moon on a clear, cloudless night from the top of the elevation. This should be done when the moon is a few hours high and is full. Note the apparent size and then walk to the foot of the declivity illustrated and view the moon from there. We have created an artificial horizon and in effect, the moon will appear larger when viewed from the foot of the hill than when viewed from the top.

Another test which will quickly demonstrate that the moon is actually of the same size in both positions may be had further by following the same procedure just outlined and using the method employed by artists for determining relative sizes of distant objects. Hold a pencil at arm's length and with the finger, mark the apparent length of the diameter of the moon from one end of the pencil. Keeping this measurement, descend the hill and from a point where the moon appears to be larger, make the same measurement. Both will be found to be the same.

## EVAPORATION

(1996) Q. 1. A. Damrauer, Brooklyn, N. Y., is conducting some experiments that involve the descending of a drop of water from a container at a rate of about one drop every three seconds. He asks: How can I cause each drop of water to evaporate before the next one is ejected from the container?

A. 1. The only reasonable method of evaporating the water as soon as it drops out is to use an electric hot plate. This is a simple contrivance consisting of a round piece of sheet iron under which is placed a heating resistance which is connected to the electric lighting circuit.

## PRINTING

(1997) Q. 1. E. G. Patterson, Columbus, O., desires to transfer printed designs from paper to zinc so that the result can be etched out. He does not desire to use a camera for photographing the original design. He asks: Can you tell me how this can be easily done?

A. 1. Probably the most successful method of those you mention would be the coating of a zinc plate with an emulsion sensitive to light, and the use of a translucent paper. The latter can be made by treating a printed sheet with some oil such as kerosene or paraffin oil. Place the translucent sheet over the zinc plate and expose to a strong light. After some experimentation you will find that the design will be transferred to the sensitive surface. Using this principle, preparations can be used that, after exposure to light, can be etched in the usual manner employed by photo-engravers.

## TOY TRAIN

(1998) Q. 1. H. Matsue, New York City, has a toy train designed to run on either A.C. or D.C. He says that he connected the train up to the 110-volt A.C. line with seven lamps rated at 14 volts each in series. The train would not run. He asks: Why?

A.1. The reason your electric train would not run when connected in series with a bank of lamps was simply because the lamps did not pass enough current to actuate the motor in the train. If lamps consuming an amperage equal to that of the motor were used, you would find that the motor would run.

## PERPETUAL MOTION

(1999) Q. 1. Albert Drapeau, Lewistown, Me., says that he has recently become interested in the study of perpetual motion, and would like to know whether there are any recent developments along this line.

A. 1. Up to the present time there has been no advancement made in perpetual motion. From the time of Archimedes and Hero, the ideas concerning perpetual motion have changed but slightly. Perpetual motion today is just as impossible as it was in those ancient times, and it is evident that the greater the number of assisting pieces of apparatus, the less efficient can the device be and, consequently, the less liable to operate.

We know that there are motors today which are running on a temperature principle. Every single day in the year there is a change in temperature. This temperature change, a perfectly natural force, may be employed to operate a clock motor and to keep it running practically perpetually. The same thing is true of the humidity in the atmosphere, which has been put to use in a similar manner. Barometric pressure is another possible method. Power from the waves; power from the sun; power from waterfalls and flowing water; power from the tides, etc., could all be construed as being perpetual, but that is not the accepted meaning of the phrase perpetual motion. By this is inferred a motor which will run, being actuated by gravity only.

We doubt if such a device will ever be made, although we are willing to grant that possibilities always exist, even though the possibility of such a device being designed is very close to absolute nothingness.

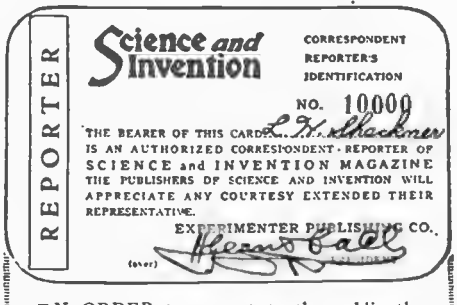
At the present time, and we have examined thousands of perpetual motion ideas, we have found nothing new. No feature contained in any of them will cause the system to operate, either theoretically or practically.

## FREEZING MIXTURES

(2000) Q. 1. G. R. Young, Detroit, Mich., refers to an article published in the February, 1924, issue of this magazine regarding a freezing mixture that will freeze water. He asks for complete directions for proceeding with this work.

A. 1. In order to obtain results with the freezing mixture described in this magazine, we would advise you to proceed as follows:

Have all the apparatus ready for the experiment and make up a saturated solution of ammonium nitrate. Place this immediately in the thimble and the thimble on a plate with a depth of 1/16 of an inch of water surrounding it. In from one to five minutes, the thimble will be found frozen to the plate. The same procedure is followed for freezing a thimble full of water, with the exception that the saturated solution of ammonium nitrate is placed in a bowl and the thimble is filled with plain water. We are sure that if you follow these instructions you will obtain the desired results. The least delay in adding the ammonium nitrate after its solution will spoil the results.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WSAI–*Cincinnati*
WWJ–*Detroit*
WOC–*Davenport*
WEAR–*Cleveland*
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## Tarrano the Conqueror

By RAYMOND CUMMINGS

(*Continued from page* 913)

you, Lady Elza." His gaze softened as he regarded her—softened almost to a quantity of wistfulness. "*You* know, Lady Elza, for what I am striving. I may—indeed I shall—conquer the worlds. But you hold in the palm of your little white hand, my real reward. . . . Enough!"

And then he offered us a sort of pseudo-liberty. We might all come and go about the Great City at will. Apparently—to the public eye—allied to Tarrano. The Princess Maida—as before—hereditary honored ruler; with Tarrano guiding the business affairs of State, as on Earth our Presidents and their Councils rule the legendary Kings and Queens. The one ruling in fact; the other, an affair of pretty sentiment.

It was this condition which Tarrano now desired to bring about. With Georg already beloved for his medical knowledge; and flying rumors (started no doubt by Tarrano) that the handsome Earth-man would some day marry their Princess.

Myself—the irony of it!—I was appointed a sort of bodyguard to the Lady Elza—the little Earth-girl whose presence in the Great City would help conciliate the Earth and bring about Universal Peace—with Venus in control.

### Interesting Articles to Appear In Feb. Issue of "The Experimenter"

Fire Under Water,
By T. O'Conor Sloane, Ph.D.

The Cathode Ray Oscillograph,
By Dr. Bacher.

Microscope Illumination by Means of Quartz Rod, By S. B. Leiter.

Mirrors Made from Chemical Convex Covers, By Earle R. Caley.

Spiral Cut Bottle.

Short Sketch of a Young Experimenter's Personal Experience.

So ran the popular fancy, guided by Tarrano. We were given our pseudo-liberty, watched always by the unseen eyes of Tarrano's guards. And there was nothing we could do but accept our status. Tarrano was guiding his destiny cleverly. Yet underneath it all, unseen forces were at work. We sensed them. The *slaans*—submissive at their menial tasks, but everywhere with sullen, resentful glances. Perhaps Tarrano realized his danger; but I do not think that he, any more than the rest of us, realized what the Water Festival was to bring forth.

That night—our first night on Venus—midway between the darkness of sunset and the dawn—we buried Wolfgar. The air was soft and warm, with a gentle breeze that riffled the placid waters of the lake. Overhead, the sky gleamed with a myriad stars—reddish stars, all of them like Red Mars himself as seen through the heavy Venus atmosphere. Largest of them, the Earth. My birthplace! Save Elza here with me on Venus, that tiny red spot in the heavens, red like the tip of a lighted arrant-cylinder, held all that was dear to me!

The funeral cortege—a solemn line of panoplied boats, started from the palace. Boats hung with purple fabric. In single file they wended their way through the city streets. From every landing, balcony, window and roof-top, the people stared down at us. The street corners were hung with shaded tubes of light, shining down with spots of color to the water.

As we passed, the people bowed their heads, hands to their forehead, palms out-

(*Continued on page* 946)

**C. J. MUSSEHL,** Pioneer Artist on the Musical Saw, has taught thousands to become Experts, Vaudeville Stars and High-Priced Entertainers.

# I'll Loan You the SAW 5 Days Free

**Be Popular—Play for Money or Fun**

JUST to prove how quick and easy you can learn to play a saw, I'll send you a genuine professional, specially tempered **Musical Saw** for 5 days trial. I guarantee that in 24 hours you can play tunes like "Old Black Joe," "Home Sweet Home," etc. Then you quickly learn latest jazz and song hits, operatic and classical music. Amazingly Simple and Easy. You don't need to know a thing about music.

## Thousands Successful by My Methods

I have taught thousands to play the Musical Saw. Many of my pupils are on the Vaudeville Stage, playing in dance orchestras, making big money as entertainers. Mail coupon and let me prove that you, too, can quickly play like a professional.

**Sweetest Music You Ever Heard**

The Musical Saw has only one rival—the violin—for sweetness and mellowness of tone. And think of your popularity and social prestige when you can play this peerless instrument! Always in demand at parties and entertainments of all kinds.

## Phonograph Record FREE

of a beautiful solo. You'll wonder at such wonderful music. But the FREE record proves it. Send for it and big free trial offer, today! Let me show you letters from pupils who are now stage celebrities. Let me tell you how you can get Saw, Bow, Soft Hammer and Resin FREE with Course of Instruction after my trial offer proves how quickly you can play.

MUSSEHL & WESTPHAL
334 West Water St. Fort Atkinson, Wis.

# Make Money Taking Pictures!

We train you quickly at home. No experience necessary. Spare time or full time. Professional camera free. Photographs in big demand by magazines, newspapers, advertisers, etc. Also train you to take better portraits than the average professional photographer! Equip you to make $50 to $100 a week in business of your own. New plan. Nothing else like it. Write today for amazing details.

**International Studios, Inc.**
Dept. 1422 3601 Michigan Ave., Chicago, Ill.

# Stammering Bill Woods

## How he overcame his handicap and became the best talker in his town and the star salesman of his firm

*By* H. L. HODGSON

*Illustrated by*

JOHN A. MAY

THE "Limited" was held up by a freight wreck ahead. I was marooned in a small but prosperous manufacturing town with but little prospect of getting out before midnight. Tired, after a hard day's work, I had just about decided to take in a movie, when the town band sailed by at the head of a torchlight procession.

Upon inquiring I learned that the local American Legion Post was celebrating the opening of its handsome new building. Forgetting the movies, I followed the crowd and experienced one of the biggest and happiest surprises of my life.

The lion of the evening was my old schoolmate, Bill Woods. Bill held the audience spellbound for three-quarters of an hour with one of the best speeches I have ever heard.

When the meeting broke up, I lost no time in pushing my way through a group of ardent admirers to Bill's side and later, as he walked to the railroad station with me, my curiosity got the best of me.

"I lost no time in pushing my way to Bill's side"

"BILL," I said, "the last time I talked with you it took you almost five minutes to answer yes or no, yet tonight you made a most remarkable address. How in the world did you do it?"

Bill laughed. "It's a long story—old man—but a mighty interesting one.

"Up until about a year ago I was a stammerer of the worst kind. Do you remember in school how the fellows made fun of me? I guess that was one of the reasons why I got poor marks. I knew my lessons, but was always afraid to get up on my feet and recite. The only tests I could ever pass were written ones.

"When I got out of school I came up here and went to work for the Johnson Company. I don't know how I ever got the job or held it, because every time I was asked a question, I got nervous and before I could make a reply my questioner would turn to someone else for the information he desired. I always knew what I wanted to say, but somehow I couldn't get it out.

"Well, other fellows, who did not know the business half as well as I did, began to pass me in both salary and position. While they moved up, I stood still at the same old job and earning the same small beginner's salary.

"I couldn't afford to make a stand for myself before the boss. If I had I would have been fired. The Johnson Company had no important places for men who couldn't talk. I had big ambitions, was vitally interested in the business and was sure I could make good on the sales force if only I could learn to speak distinctly. In my day-dreams, I pictured myself out on the road putting across big sales, earning big money and holding down a real job. Then I would awake and be more miserable than ever."

"Didn't you ever try to be cured?" I interrupted.

"Time and time again—I never missed even the slightest chance," he replied. "But it seemed of no use, and finally I concluded I could never be cured.

"THEN one day, one of the fellows in the office showed me a letter from a friend of his. This friend, a short time before, had stuttered and stammered just as I did then. The letter told how he had been entirely cured by a new scientific method at a regular school for stutterers and stammerers.

"At first I did not pay much attention to it. What was the use? I had tried one so-called cure after another without result. Over and over again my hopes had been aroused, but each time I had failed and as a result had become more despondent than ever.

"But this fellow insisted that the Bogue Institute was entirely different. He told me his friend had also tried all kinds of reliefs without results, but that he had been absolutely cured in a few weeks by attending classes under Mr. Bogue.

"Well, a few days later I saw one of the Institute advertisements in a magazine. After reading it I sent for full information with the understanding that I was not obligating myself in any way.

"In a few days I received all their descriptive literature and a catalog. I learned that Bogue Institute at Indianapolis was a resident school with dormitories, classrooms and a regular schedule of work just the same as any other boarding school or college.

"Another thing that interested me was the fact that the founder of the Institute, Benjamin N. Bogue, had stuttered and stammered for twenty years and had first worked out this scientific cure for himself. Once cured of the trouble that had made his own life so miserable, he was too big-hearted to stop. So he decided to help others. Soon he had a large class and, spurred on by wonderful results, he started the Bogue Institute and made the scientific cure of stammerers his life work.

"The catalog showed pictures of the school and there were numerous letters written by graduates who had been cured. After carefully looking over the literature I became convinced that at least this was a more reasonable idea than any I had ever tried before.

"With the hooks and literature, I also found a diagnosis blank. This was a regular diagnosis form, but very easy to fill out. On it I wrote all my symptoms and a general history of my particular case and sent it in.

"A few days later I received a personal letter from Mr. Bogue in which he completely and correctly diagnosed my case from the questions I had answered. He seemed to thoroughly understand my condition and once again I entertained hopes of being cured.

"SO I wrote and had my name placed on his registry list. I found the school to be always crowded. But then the courses were short and with the cure and graduation of students new vacancies were occurring constantly.

"In about two weeks after I had sent in my application I received a letter to report at the Institute on a certain day.

"Then for once I mustered up nerve enough to go to the boss and ask for some time off. When I finally managed to make my request plain he was more than anxious to let me go. 'Good luck to you,' he said, 'I hope you will be completely cured.'

"Well, to make a long story short, six weeks after I enrolled under Mr. Bogue, I left his Institute absolutely cured of the affliction that had made so many years miserable for me. Not only was I able to talk without stuttering or stammering, but I had learned how to speak correctly. I had mastered the art of becoming a convincing speaker! Talking became a pleasure instead of misery for me.

"Best of all, my six weeks at Bogue Institute were really enjoyable. The Institute is founded on the soundest of principles and Mr. Bogue is a big-hearted man who is deeply interested in his work and gives every student his individual attention.

"After I returned to work, advancement came rapidly. At last I was able to cash in on the things I had learned about our business. I asked for a chance to go on the road. Luckily there happened to be a vacancy at that time. I was given the opportunity I had dreamed of so long and I have made good. My salary was raised twice in nine months, and three months ago I was made sales manager with headquarters at the new plant here."

IF YOU stutter or stammer, do what Bill Woods did. Benjamin N. Bogue, who cured himself and hundreds of other men and women, boys and girls, can cure you!

The Bogue Institute was established a quarter of a century ago. It is an old institution, founded on good sound principles and being run on honest, business-like methods. Results, under the Bogue method, are guaranteed.

The average student has remained at Bogue from three to eight weeks. It is a resident school—not a mail order organization. The school surroundings are pleasant and comfortable. The faculty is composed of experts in their line of endeavor.

If you stammer or stutter, find out for yourself what the Bogue Institute can do for you.

Without obligating yourself in any way fill out the coupon below. By return mail you will receive full information regarding this sure, scientific cure for stammerers and stutterers.

Or if you do not stutter, but know of someone who does, either see that this story of Bill Woods is called to his attention or send the Bogue Institute his name and address. Your name will not be mentioned in any way. And the Bogue Institute may be the means of opening up a whole new world for him.

---

BENJAMIN N. BOGUE
8125 Bogue Bldg. 1147 N. Illinois St.
Indianapolis, Ind.

Without obligation on my part, please send me full information regarding the Bogue Institute and the new scientific cure for stammerers and stutterers.

Name.....

Address.....

# 6 WEEKS AGO he clipped the coupon

Other fellows had left him in the social background. Girls avoided him. He was missing all the modern fun. Then one day he read an advertisement. It held a promise of popularity if he would learn to play a

BUESCHER True Tone Saxophone

He thought himself musically dumb. Still, the ad said it was easy. He mailed the coupon, and later sent for a Saxophone for six days trial. Before the end of the week he was playing easy tunes. That was six weeks ago, and today he's "popularity" itself. He is always welcome, everywhere.

***You can do it too! If you try***

If you can whistle a tune you can master an easy fingering Buescher Saxophone. 3 lessons given on request, with each new Saxophone, teach scales in an hour and within a week you can be playing popular tunes. 304A

***Six Days Trial - Easy Terms***

Try any Buescher Instrument in your own home for six days. See what you can do. Satisfaction guaranteed or no sale. If you like the instrument pay a little each month. Play as you pay. Clip the coupon below. Send for beautiful book, "The Story of the Saxophone" or literature describing the instrument of your choice. Send it today. Get started.

BUESCHER BAND INSTRUMENT CO.
*Everything in Band and Orchestra Instruments*
1369 Buescher Block Elkhart, Indiana

Free *This beautiful book gives the complete history of the Saxophone, and tells why the Buescher is so easy to learn to play. In it you will find the first lesson chart and many interesting pictures. You must have this fine book.*

**Clip the Coupon NOW!**

Mail BUESCHER BAND INSTRUMENT CO.
1369 Buescher Block, Elkhart, Indiana.
Gentlemen: I am interested in instrument checked below:
Saxophone☐ Cornet☐ Trombone☐ Trumpet☐
Mention any other ----------
Name ----------
Street Address ----------
Town ---------- State ----------


## Tarrano the Conqueror

(*Continued from page* 944)

ward. The gesture of grief. From one building came a low chant, with music of a minor strain supporting it.

"Honor to Wolfgar! The man who gave his life for our Princess. Honor to Wolfgar!"

We came to the edge of the city. The lake here narrowed to a river—a length of winding river opening to the pond which was the burial place of Eternal Peace. On Tarrano's barge, with Elza and Georg, we led the way. Maida was not with us. I asked Tarrano where she was, but solemnly he denied me.

At the burial waters—on the sloping banks of which a silent throng had gathered—we landed. And following us, the other vessels of the cortege came along and stopped beside us. The pond was dotted with white markers for the graves. The whole scene unlighted, save for the stars, and the red and purple aural lights of the Venus heavens, which mounted the sky at this midnight hour. A great, glowing arc—the reflected glow from a myriad cluster of tiny moons and moon-dust, encircling Venus. The soft light from it flooded the water and the tombs with a flush of red and purple.

## Articles to Appear in February Motor Camper and Tourist

Along the Old Santa Fe Trail,
By Omar Barker.

Camping Along Historic Trails of Southern New Mexico, By L. A. Cardwell.

The Romance of New Mexico,
By Gilean Douglas.

A Trip to Hopi-Land,
By Bonney R. Gaastra.

El Morro,
By Isabel Florence Storey.

Trailer Construction,
By H. H. Buckwalter.

As we lay there against the bank, with that silent throng breathlessly watching, from down the river came the last vessel of our cortege. It made a scene I shall never forget. The bier. Draped in purple. A single, half-naked *slaan* propelling it with a sweep from its stern. The body of Wolfgar lying on its raised prow—his dead, white face, with peace upon it. Beside the body, the lone figure of Maida, kneeling at Wolfgar's head, with her white, braided hair falling down over her shoulders. Kneeling and staring, almost expressionless; but I knew that with her whole heart she was speeding the soul of Wolfgar to its eternal peace.

### CHAPTER XX

### THE MENACE UNSEEN

That day following the burial of Wolfgar, there was nothing of importance occurred. No news from the Earth could get in. I felt that the Earth might be planning an attack. Probably was, since war had been declared. Yet that of course was months away.

Tarrano apparently was engaged in the pleasurable triumph of the coming Water Festival. All day he seemed engaged in planning it. But I knew that he was engaged secretly with far sterner things. Concerning the Cold Country, which lay a day's journey from us. His secret activities were there, I learned. But what they were, I did not know.

The Water Festival was all we talked of. That afternoon, Tarrano describing it, said smilingly:

(*Continued on page* 948)

TO prove I can make you autos at home so you can earn BIG PAY Right NOW, I will send you absolutely FREE four complete lessons with charts, with which you can actually earn money at once repairing autos.

Enos Miller earned $50 the first week, Joe Garcia made $7 the same day he received the work sheets.

I have trained thousands of men for auto trades during 21 years. Many now earn $8,000 to $15,000 a year. National's methods are time-tested and proved. Now I have reduced the wonderful course given in this $1,000,000 school of shops to paper, so you can learn at home exactly as other men learn here—by actual practice.

SEND NO MONEY. You have nothing to lose! I don't want a cent of money! I only want to prove to you that I can qualify you at home for BIG PAY in the fascinating automotive industry. These 4 FREE Auto Repair charts are my proof. Send at once! You be the judge!

J. A. Rosenkranz PRES.

NATIONAL AUTOMOTIVE SCHOOL,
Dept. 330, 4004 So. Figueroa St.,
Los Angeles, Calif.

Send me your 4 FREE Auto Repair Charts, with which I can begin earning money at once.

Name .....
Address .....
City ..... State .....

# Music Lessons WITH AN ACCREDITED SCHOOL At Home

**A Complete Conservatory Course By Mail** Wonderful home study music lessons under great American and European teachers. Endorsed by Paderewski. Master teachers guide and coach you. Lessons a marvel of simplicity and completeness.

The only recognized Conservatory of Music giving lessons by the UNIVERSITY EXTENSION METHOD.

The ideal of a genuine Conservatory of Music for home study based upon lessons containing the cream of the life's teaching experience of Master Musicians, reinforced by the individual instruction of specialists, is now attained.

*The instruction of a master—the individual touch of an accomplished teacher—is yours to command from the very moment you enroll.*

The University Extension Conservatory, by adopting the Personal Instruction Method, has placed home music study beyond question as to results. Anyone can learn at home.

**Any Instrument** Write telling us course you are interested in—Piano, Harmony, Voice, Public School Music, Violin, Cornet, Mandolin, Guitar, Banjo, or Reed Organ—and we will send our Free Catalog with details of course you want. Send now.

UNIVERSITY EXTENSION CONSERVATORY
251 Siegel-Myers Building Chicago, Illinois

Returns its Cost OVER AND OVER

The "Trousers' Friend"

This scientific device made of everlasting steel, nickel plated, positively removes baggy knees and automatically preserves the creases without pressing, without dampening and so easily that anyone can adjust it in a moment. Hang your trousers in a "Trousers' Friend" in the evening and put them on spick and span in the morning. Takes very little room in grip. Works equally well at home, in Hotel or Pullman.

Order One To-Day: Send No Money

Pay the Postman $1.75 and postage. Use it thirty days. If not satisfactory your money returned. If you remit with order we pay postage.

NELSON MANUFACTURING COMPANY
55 New Montgomery St. San Francisco

Secure An Agency: The "Trousers' Friend" is filling a World need. We want you to present it to millions waiting for it. Write to-day.

## LUMINOUS PAINT

**Make Your Watches, Clocks, Etc., Visible by Night** The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light, rendering it perfectly visible** in the dark. **THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. Bottle containing sufficient to coat several small articles, **Price 25c.** Larger sizes **50c** and **$1** postpaid. **Johnson Smith & Co., Dept. 314, Racine, Wis.**

## The "Little Giant" Typewriter

**A First Class Writing Machine For $1.50**

A perfect little typewriter for $1.50. There are thousands of persons who would like to use a typewriter, but whose needs and business do not warrant the expense attached to the purchase and use of a fifty or seventy-five dollar machine. To such persons we confidently recommend our Little Giant. It is strongly made, but simple in construction, so that anyone can quickly learn to operate it, and write as rapidly as they would with pen and ink. The letters of the alphabet most frequently used are so grouped as to enable one to write rapidly, the numerals 1 to 10, and the punctuation marks being together. With this machine you can send your best girl typewritten love letters, address envelopes, make out bills, and do almost any kind of work not requiring a large, expensive machine. With each typewriter we send a tube of ink and full printed instructions for using the machine. **Price complete $1.50 by mail postpaid to any address in the world.**

## Every Boy His Own Toy Maker

Greatest boys' book written. Tells how to make a Pinhole Camera, a Canoe, model Railroad, a Telephone, Boomerang, Telegraph Instrument, Box Kite, Talking Machine, Microscope, Electric Motor, Electric Door Bell, Water Wheel, Paddle Raft, a pair of Skis, a Dog Sled, Bird House, Rabbit Yard, etc. 64 pages. 150 illustrations. **PRICE, 10c postpaid; 3 for 25c.**

## GOLD TEETH

You know how fashionable it is to have gold crowns—if you can afford it. These gold-finished shells fasten over your real teeth and look like very wealthy fillings. Can be slipped on and off in an instant. Get some and surprise your friends. **PRICE 6 Cents Each, 3 for 15c, or 50c for 1 doz., postpaid.**

**JOHNSON SMITH & CO., Dept. 314, Racine, Wis.**

## U.S. BABY TANK

**25 Cents**

**It goes with real Yankee Pep by its own power**

Most remarkable Toy ever invented. By drawing the Tank backward, either with the hand or over the floor or table and then placing it down, it will crawl along, overcoming all obstacles, in the same lifelike manner as the larger Tank that proved so deadly in the great war. What makes it go is somewhat of a mystery, for there is no mechanism to wind up as is usually understood with mechanical toys, yet this tank will keep plodding along ten times longer than the ordinary run of toys. It will perform dozens of the most wonderful stunts; it will go backward or forward at will. 2½ inches long. **Price only 25 cents prepaid.**

## BOYS! BOYS! BOYS!

## THROW YOUR VOICE

Into a trunk, under the bed or anywhere. Lots of fun fooling the teacher, policeman or friends.

## THE VENTRILO

a little instrument, fits in the mouth out of sight, used with above for Bird Calls, etc. Anyone can use it.

**Never Fails. A 32-page book on ventriloquism, and the Ventrilo, ALL FOR 10c postpaid.**

## MIDGET BIBLE

**GREAT CURIOSITY**

Smallest Bible in the world. Size of a postage stamp. **200 Pages.** Said to bring good luck to the owner. A genuine work of art. Must be seen to be appreciated. Make good money selling them to friends, church acquaintances, etc. PRICE **15c** each, **3 for 40c, 12 for $1.35, 100 for $7.50.** Also obtainable in Leather Binding, with gold edges. **Price 50c each, 3 for $1.25, $4.50 per doz.**

**Magnifying Glass** for use with Midget Bible, **15c**

## K.K.K

Everything about the **Ku Klux Klan** told in a clear, fearless manner. Book tells all. How it started and was suppressed in 1871—The New Ku Klux Klan—How organized—How members are enrolled—Oath of the Klan—**Questions for Candidates**—Creed—Objects of the Order—Obedience—Fidelity—Pledge of Loyalty—**Ku Klux Klan and the Masons**—The Jews—The Masons—Real K. of C. Oath—The Negro Ku Klux Klan, etc., etc. Latest and most complete book on the Klan published. **Price, 35c,** postpaid.

## SEX INDICATOR

Hold the **MAGIC INDICATOR** over a man's hand instantly it moves in a straight line, backward and forward. Hold it over a woman's hand and it describes a complete and continuous circle. The same action can be obtained over a letter written by a man or woman, etc. It is fascinating; baffling. We have never been able to figure out how it's done—but we've never seen it fail. Many novel and entertaining feats may be performed with the Sex Indicator. For example, similar results can be obtained with animals, cats, dogs, rabbits, over birds, chickens, canaries, etc. Also used to predetermine the sex of chickens and birds, etc., in fact it is sold as a patented egg tester in Europe. **Price 25c, or 3 for 65c, postpaid.**

## STAGE MONEY

With a bunch of these bills, it is easy for each person of limited means to appear prosperous by flashing a roll of these bills at the proper time and peeling off a genuine bill or two from the outside of the roll, the effect created will be found to be all that can be desired. **Prices, postpaid: 40 Bills 20c, 125 for 50c, or $3.50 thousand postpaid.**

## Wonderful X-Ray Tube




A wonderful little instrument producing optical illusions both surprising and startling. With it you can see what is apparently the bones of your fingers, the lead in a lead pencil the interior opening in a pipe stem, and many other similar illusions. A mystery that no one has been able to satisfactorily explain. **Price 10c, 3 for 25c, 1 dozen 75c. Johnson Smith & Co.**

## Good Luck Ring

**Quaint and Novel Design**

A VERY striking and uncommon ring. Silver finish, skull and crossbone design, with two brilliant, flashing gems sparkling out of the eyes. Said by many to bring Good Luck to the wearer, hence its name, **Good Luck Ring.** Very unique ring that you will take a pride in wearing. **ONLY 25 CENTS.**

## Exploding Cigarettes

**JUST LIKE ORDINARY CIGARETTES, BUT SUCH REAL STARTLERS!** The box contains ten genuine cigarettes of excellent quality. They appear so real, but when each cigarette is about one-third smoked, the victim gets a very great surprise as it goes off with a loud **BANG!** A great mirth provoker yet entirely harmless. **Price 25c per box.**

## Popular Watch Charms

**15c**

**ONLY 3 for 40c; $1.35 doz.**

Very pretty little curiosities and decidedly novel. Fitted with Magnifying Lenses that enlarge the pictures to a very surprising degree; in fact, it seems almost incredible that a clear picture could be possible in such a small compass, and how sharp and distinct they show up when you look through. Come in assorted views—Actresses, views of Panama Canal, Lord's Prayer in type, etc.

## CIGARETTE MAKER

Roll your own and save money. Makes them better and quicker besides saving more than half. Use your favorite brand of tobacco. Neat, useful and handy. Pocket size, weighs ¾ oz. Made entirely of metal, nickel-plated. **Price 25c postpaid.**

## MAGIC FLUTE

**Wonderfully Sweet Toned and Musical**

Post Paid **25c**

The Magic Flute, or Humanatone, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it which, when once acquired after a little practice will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is as charming as it is surprising.

## NEW BOOK ON ROPE SPLICING

**Useful Knots, Hitches, Splices, etc.**

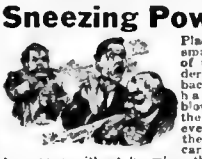
A most practical handbook giving complete and simple directions for making all the most useful knots, hitches, rigging, splices, etc. Over 100 illustrations. All about wire rope attachments, hailing, blocks, tackles, etc. 37 Heraldic Knots illustrated. Of great value to mechanics, riggers, campers, boatmen. Price 20c ppd.

## BLANK CARTRIDGE PISTOL

**Price $1.00 Postpaid**

This well made and effective Pistol is modelled on the pattern of the latest type of Revolver, the appearance of which alone is enough to scare a burglar, whilst, when loaded, it will probably prove just as effective as a revolver with real bullets, without the danger to life. It takes the standard .22 Calibre Blank Cartridges, that are obtainable most everywhere. Even the most timid women can use it with perfect safety and frighten a thief without risk to herself or anyone else. **A Great Protection Against Burglars Tramps and Dogs.** You can have it lying about without the danger attached to other revolvers. We sell large numbers around the 4th of July. Well made of solid Metal. **PRICE ONLY $1.00 Postpaid. Blank Cartridges 22-cal., shipped by express only, 50c per 100. Johnson Smith & Co., Dept. 314, Racine, Wis.**

## Sneezing Powder



Place a very small amount of this powder on the back of your hand and blow it into the air, and everyone in the room or car will begin to sneeze without knowing the reason why. It is most amusing to hear their remarks, as they never suspect the real source, but think they have caught it one from the other. Between the laughing and sneezing you yourself will be having the time of your life. For **parties, political meetings, car rides,** or any place at all where there is a gathering of people, it is the greatest joke out. **Price 10c or 3 for 25c**

## Mystic Skeleton

**10c and pd.**

A jointed figure of a skeleton 14 in. in height, will dance to music and perform various gyrations and movements while the operator may be some distance from it.

## Serpent's Eggs

Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most lifelike manner. **Price per box 10c ppd.**

## Microphone Transmitter Button

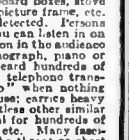
**$1.00 POST-PAID**

You can easily make a highly sensitive detectophone by using this Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. It is simple and inexpensive. You can install an outfit in your home and hear conversations being held all over the house. You can connect up different rooms of a hotel. This outfit was used by secret service operatives during the war. It is being used on the stage. It is ultra-sensitive and is the greatest invention in micro-phones. You can mount the button almost anywhere—cardboard boxes, stove pipes, stiff calendars, on the wall behind a picture frame, etc. Button is so light and small it cannot be detected. Persons can be overheard without suspecting it. You can listen in on conversations in another room. A deaf person in the audience can hear the speaker. Connected to phonograph, piano or other musical instrument, music can be heard hundreds of feet away. Button may be used to renew telephone transmitters; often makes an old line "talk-up" when nothing else will. The ideal microphone for radio use; carries heavy current and is extremely sensitive. Amplifies radio signals. Countless other similar uses will suggest themselves. Experimenters find the Button useful for hundreds of experiments along the lines of telephones, amplifiers, loud speakers, etc. Many fascinating stunts may be devised, such as holding the button against the throat or cheat to reproduce speech without sound waves. $5.00 is given to anyone who sends in a new suggestion for the use of the Button providing the manufacturers find it suitable for use in their literature. **PRICE $1.00 POSTPAID ANYWHERE.**

## ANARCHIST BOMBS

One of these glass vials dropped in a room full of people will cause more consternation than a limburger cheese. The smell entirely disappears in a short time. **10c a Box, 3 Boxes for 25c**

## INVISIBLE INK



The most confidential messages can be written with this Ink, for the writing **MAKES NO MARK.** Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private memorandums away from prying eyes. Great fun for playing practical jokes. **Only 15c Bottle**

## ITCHING POWDER

This is another good practical joke; the intense discomfiture of your victims to everyone but themselves is thoroughly enjoyable. All that is necessary to start the ball rolling is to deposit a little of the powder on a person's hand and the powder can be relied upon to do the rest. The result is a vigorous scratch, then some more scratch, and still some more.

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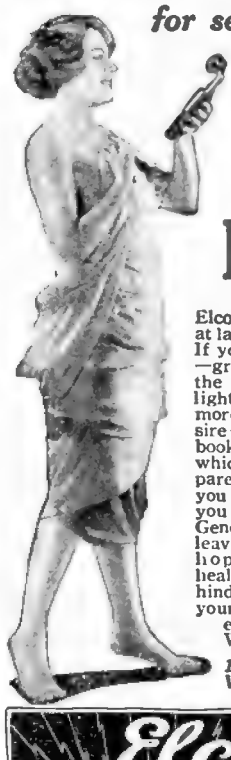

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## Tarrano the Conqueror

(*Continued from page* 946)

"They say it is for me. But, Lady Elza—it is *I* who plan it—for you. You have not seen the Red Woman." A gleam of amusement played upon his lips; but as he regarded Elza, I saw another look—of speculation, as though he were gauging her.

"The Red Woman, Lady Elza. She will preside tonight. You will find her—very interesting. We will watch her together, you and I."

I did not know then what he meant; but I remembered the words later, and understood only too well.

Just after sundown, when I chanced to be in a small boat alone, near the palace, the first of two significant incidents occurred. From the shadows beneath a house, the head of a swimming man emerged. A *slaan*, and he gripped the sides of my boat as I drifted.

"Wait, Earth-man." He spoke in the quaint universal language, which I understood, though imperfectly.

I gazed at him. A bullet-like head, with sullen, blazing eyes. He added: "We do not blame you—or your woman Elza—or the Princess Maida. Have no fear, but guard yourself well tonight."

Before I could speak he had sunk into the water, swimming beneath it. I could see the phosphorescence of his moving body as he swam away into the shadows beyond my line of vision.

The other incident came a moment later. As I was gazing down into the water I saw a moving metal shape. A triangular metal head, as of a diver's cap. More than that, it turned upward; and behind its pane was a man's face. Unfamiliar to me—yet the face of an Anglo-Saxon man of Earth! Unmistakable! It stared at me a moment—no more than three or four feet below my boat. And then it moved away and vanished.

I had no opportunity to speak alone with Elza, or Georg or Maida that entire evening. Always Tarrano was with us. We sat upon the palace balcony, we men smoking our arrant-cylinders. Tarrano talked and joked like a care-free youth. He was very courteous to Elza, with a holiday spirit upon him. But his eyes never relaxed; and often I could see him measuring her.

The aural lights mounted the sky. The holiday spirit which was on Tarrano was spreading everywhere throughout the city. Boats gayly bedecked—in such contrast to the funeral cortege of poor Wolfgar just the night before—began passing the palace on their way to the festival waters. Men and laughing girls thronged them. All with red masks covering their faces. The men in grey tight-fitting garments, with conical caps and flowing plumes; the girls in bright-colored, flowing robes, and tresses dangling with flowers entwined in them.

The balcony upon which we sat was close above the water level. The barges, of every size and kind, glided past. Sometimes the girls would shower us with flower petals. One small boat paused before us. A girl stood up to wave at me. Her hand, held up with the loose robe falling back from her slim white arm, offered me a huge scarlet blossom. The love offering. As I hesitated, her laughter rippled out. She tore the mask from her face. Her red mouth was smiling; her eyes, provocative, were dancing with mischief. She tossed the flower into my face as her escort, with a shout of mock anger, pulled her back to him.

Their boats glided on.

Other boats passed; some with girls gayly strumming instruments of music. One boat with a man strumming, and a girl on a small dais, dancing with a whirl of black veils. As they came opposite to us another man in the boat reached up and pushed the

(*Continued on page* 954)

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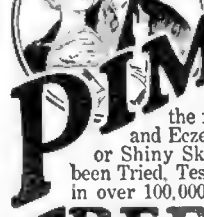

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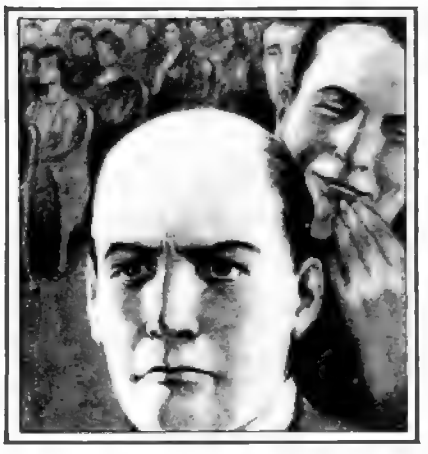
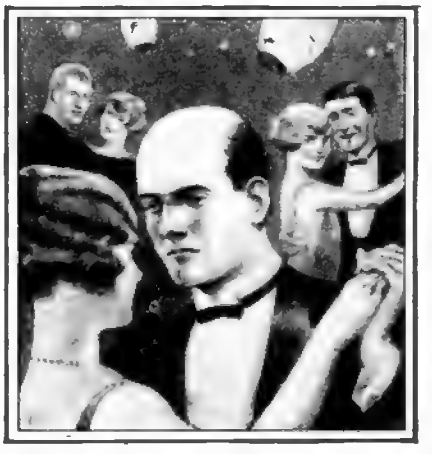
# Why Be Embarrassed By Approaching Baldness





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Well, don't let them keep on making fun of you. You can stop falling hair and grow brand new hair—or pay nothing. For I've perfected a new, scientific treatment that I absolutely *guarantee* will give you a new growth of hair in 30 days—or the trial won't cost you a cent.

Thousands of others have grown healthy, vigorous, new hair by my method. And no matter how many hair tonics, "restorers," or other treatments you have used without results—no matter how rapidly your hair is falling or how thin your hair may be—I offer you the same opportunity.

### New Hair or Not a Cent Cost

Perhaps you've wasted a good many dollars on ordinary hair tonics, salves, and other ordinary methods without results. And so you are skeptical. I don't blame you. *But how could such methods ever grow hair when they merely treat the surface conditions and don't touch the real cause of most hair loss—starving, half-alive hair roots?* Would it help a weak, sickly plant to rub the stem and leaves with "growing fluid"? Not by a long shot! You've got to nourish the *roots*. And that's just what is necessary to stimulate hair and make it grow.

That's exactly what my scientific treatment does—gets right to the *cause* of most hair troubles, the under-nourished, dormant *roots*, nourishes them, and gives them new life. It is not a new tonic, salve or ointment. It is the result of long years of scientific research and experience gained in the successful treatment of hundreds of cases of hair troubles at the Merke Institute, Fifth Avenue, New York. Yet it is simple and can be used without the slightest discomfort or inconvenience in any home where there is electricity.

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"Your Thermocap has done a wonderful thing in bringing back my hair where all other things had failed. The top of my head is now entirely covered with hair after using the Thermocap for about two months and new hair seems to be coming in all the time." Harry A. Brown, 21 Hampton Place, Utica, N. Y.

Just a few typical letters from delighted users are quoted on this page. Read what these boosters have to say. There are thousands of other enthusiastic endorsements of the Merke method of treatment in our files which are open for the inspection of any interested person. Day by day the collection grows larger.

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Of course there are a few cases of loss of hair that nothing in the world can help. Yet so many hundreds of men and women whose hair was coming out almost by "handfuls" have seen their hair grow in again as the shrunken roots acquired new life and vitality that I am willing to let you try my treatment at my risk for 30 days. Then if you are not more than delighted with the new growth of hair produced, write to me immediately. Tell me my system has not done what I said it would. And the 30 day trial won't cost you a cent.

Don't let them call you "baldy." Don't let them make life miserable with their jokes about your scanty hair. I've proved to thousands of others that the humiliation of baldness is now in most cases entirely unnecessary. And if I can't do the same for you—the trial costs you nothing.

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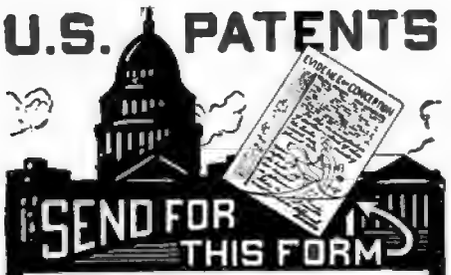


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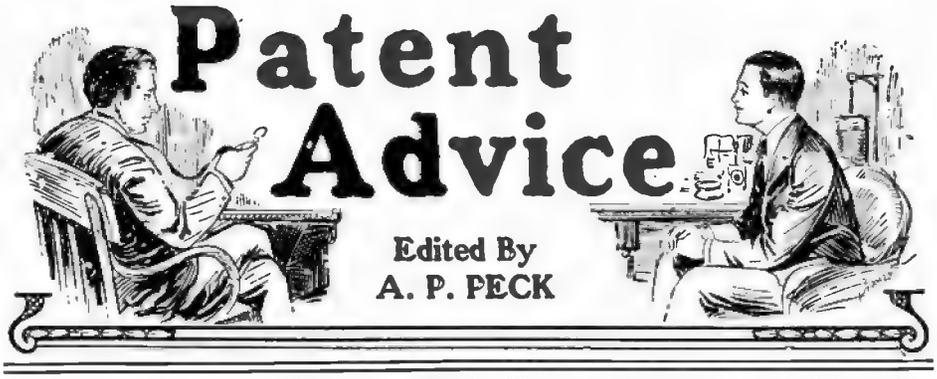

Edited By
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Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given. (No questions answered this month, owing to special article.)

## Marketing a Patented Invention

### By Leo T. Parker

(*Continued from January issue*)

THE cost of sending out one hundred or more letters is trifling. Lists of manufacturers in classified form can be obtained from a multigraph letter firm. It is only reasonable to expect that many of the firms who receive the letter will be interested in knowing the amount of money expected for the outright purchase of the patent, if the invention appears to be a salable one covered by a broad patent. A few of them may submit an offer.

At this point it is very important for inventors to understand that no reasonable offer should be refused. From the tone of the replies and the number received, a very sensible conclusion can be formed as to the apparent value of the patent, especially if any offers are submitted. If the amount of money available for an outright sale is not satisfactory then there remain other ways of securing profits from the invention. If, however, the patentee does not intend to manufacture and sell the patented articles himself or if he has no other prospects of obtaining profits from the invention, then he should accept the best offer immediately, unless, of course, it happens to be too low to warrant consideration and acceptance.

Inventors should always bear in mind that the life of a patent (except for designs) is 17 years and, for example, if the patent is worth $17,000.00 when first it is issued, the value of the patent depreciates at the rate of $1,000 per year until at the end of 17 years it is worth nothing, as then it is public property and may be manufactured without restrictions by anyone. Also, sometimes an invention appears to be worth considerably more than any firm will offer for it, but unless the patentee intends to enter into the manufacturing business, even small offers should be seriously considered before being refused.

The best method of obtaining a large price for the outright sale of an invention is to enlist the simultaneous interest of two or more competing firms, whereby the procedure assumes the aspect of an auction sale, in which the highest bidder prevails, with a result that considerably more money usually can be obtained for the patent than when only one firm knows that the patent is for sale.

The most common trouble that I have found with inventors is that the majority of them expect a great deal more money from the cash sale of a patent than the invention really is worth. If the invention is at all complicated a large amount of money is required to manufacture and market it. Much valuable time is consumed in arranging the details, and in addition to these necessary items, even after the business is established and the required capital is invested, if the invention proves profitable to those persons who have risked the actual cash to promote the sales, there always are a multitude of firms and individuals who desire to manufacture and sell competing and similar devices. The practically certain termination of the resultant controversies is that the purchaser of the patent will find it necessary to expend large sums of money in infringement proceedings for the purpose of adjudicating the patent. Moreover, there is the ever-present risk in purchasing a patent, that it may be declared invalid finally by the courts, in which event it is worthless and any person or firm is privileged to manufacture and sell the invention.

Quite a majority of persons are of the opinion that a patent itself gives protection to the inventor against infringers. It positively does not. A patent merely gives its owner the privilege of entering court and bringing suit against an infringer so that both sides of the case may be presented before the court, which renders an opinion as to the rights of the parties involved in the litigation and controversy.

Also, a surprisingly large number of inventors and other persons believe a patent is rendered valid simply because it is issued by the United States Government. But this is not a fact. As a matter of fact, there are a multitude of ways of having a patent declared invalid, one of which is to show the court that it was in successful and practical use by another person prior to its invention by the patentee.

Therefore, it can easily be understood why a person who buys a recently issued and unadjudicated patent cannot, in justice to himself, afford to pay a fabulous price for it.

Of course, after a patent has been before the courts and has been finally declared valid, it is then practically a certain protection to its owner against other persons making and selling a similar and competing product during the remaining life of the patent. Money invested in an adjudicated patent has almost gilt-edge security. But new suits can always be brought to invalidate it.

Obviously the most profitable method of disposing of a patent is for the patentee to invest sufficient money to popularize his invention through the country, providing, of course, that his business experience and ability will enable him to successfully manage such a gigantic project. On the other hand I have known of energetic and experienced persons who began merely to peddle their inventions from house to house and later developed into millionaires through the profits received from the gradually established business. In fact one of the wealthiest manufacturers of fountain pens was a poorly paid life insurance salesman when he conceived the idea of a present nationally known and used pen. He resigned his position immediately and began to make the pens in his cellar. The first year was hard going and a net profit of only $600 or $12 per week, was earned, but each year proved more profitable until today the sweepings from the floor of the room in which the gold points are polished brings $15,000 per month.

Thomas A. Edison's first salable invention brought him about $18,000, but it was worth considerably more. Yet at the same time he had no capital with which to manufacture and sell it, so he accepted the comparatively small sum of money

(*Continued on page* 952)

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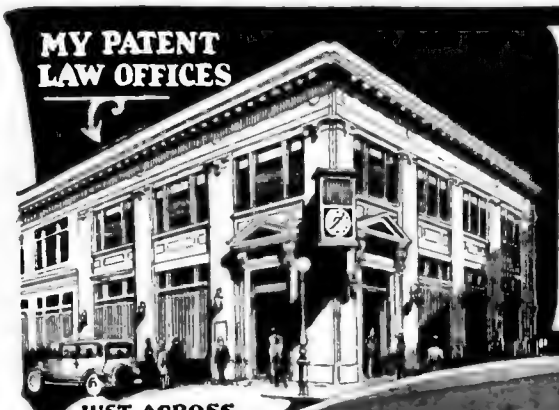


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## Marketing A Patented Invention

By LEO T. PARKER

(*Continued from page* 950)

and utilized the returns to experiment with other ideas. Soon another invention was patented for which he received $40,000.

When attempting to sell a patent for a cash sum it is advisable, when practical, to build a model and chart the various advantages such as cost of manufacture, efficiency, simplicity of operation, economical operation, and all other points in comparison with competing products. In this manner, when taking a fair volume of sales as a standard, the approximate value of the patent for 17 years may be estimated, thus providing a reliable [illegible] upon which the requested selling price of the patent can be convincingly shown to be reasonable.

A complicated invention involves other considerations, simply because considerably more money and experience is required to successfully market it. Therefore, unless an inventor is possessed with almost unlimited finances it is better for him to organize a company to promote the invention and take a portion of the stock for his payment. It is best for an inventor to retain at least 51% of the stock for his interest to insure himself a safe foundation upon which to stand in later organization and sales promotion. Sometimes investors will not advance money to promote an invention and permit the inventor to retain a controlling interest in the company, but at any rate the inventor should insist for it as his payment.

If a company is not organized then it is best to interest an established manufacturer in purchasing a complicated invention, or to sell it on a royalty basis with a reasonable cash payment when the contract is signed.

## Artists of the Microphone

By CHAS. D. ISAACSON

(*Continued from page* 931)

cannot handle them. We figure there are at least fifteen thousand telephone calls waiting in New York and Brooklyn alone, and there are hundreds of out-of-town calls." I do not think I will again give my numbers to find out if people are listening in.

Have you heard that WRNY has been honored by the Metropolitan Opera Company in having been chosen as its official broadcasting station? This is the first time that the Metropolitan Opera Company has paid attention in any way to the radio. We believe it is a precursor and forerunner of many further developments from a radio point of view. My compliments again, if you please, to Mr. Otto H. Kahn, Giulio Gatti-Casazza, Edward Ziegler and Billy Guard.

Now WRNY is the official station of the Federated Women's Clubs of America. Under the direction of Mrs. Edgar Cecil Melledge the strength of the Women's Clubs expresses itself through this station.

A little understanding of what this means might be conveyed by this fact: there are more than four hundred thousand clubwomen in New York City alone, more than eight hundred thousand in New York State and more than four million in America. The opening gun in this direction was very impressive. The Grand Ball room was filled on the morning of November 17 with the leaders in women's club life, including such women as Mary Garrett Hay, Mrs. William Dick Sporborg, Mrs. Charles M. Dickinson and Mrs. John Clapperton Kerr. You see WRNY is gradually becoming the station of big groups.

And now I want to tell you what is the most important thing that has happened since I wrote you last. I have just sent to press the *Radio Forecaster*. It is a 64-page book which gives a six months' program of WRNY from December 15 to June 15, with pictures of all the artists who are featured, and stories about them which enable the WRNY listeners to know the interesting

(*Continued on page* 964)


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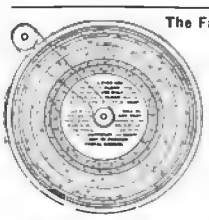

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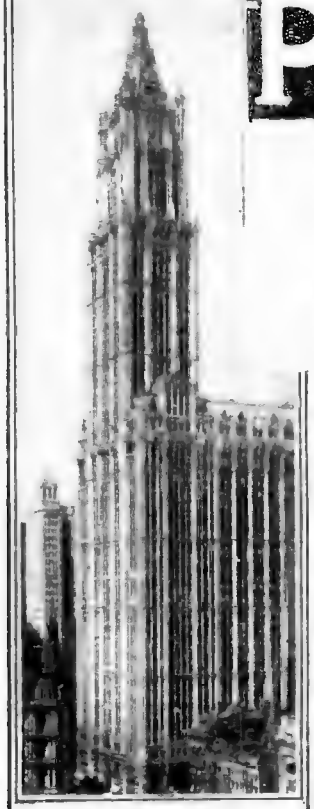

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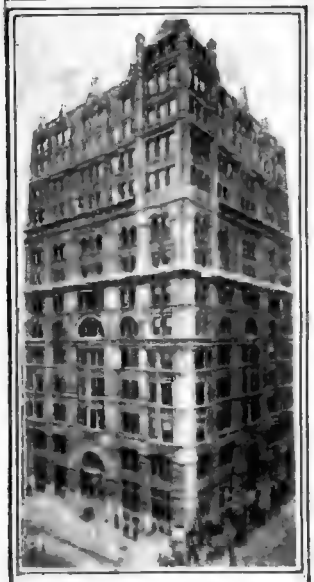

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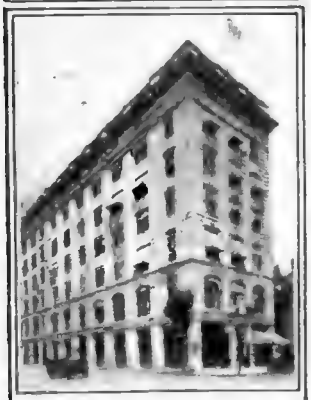

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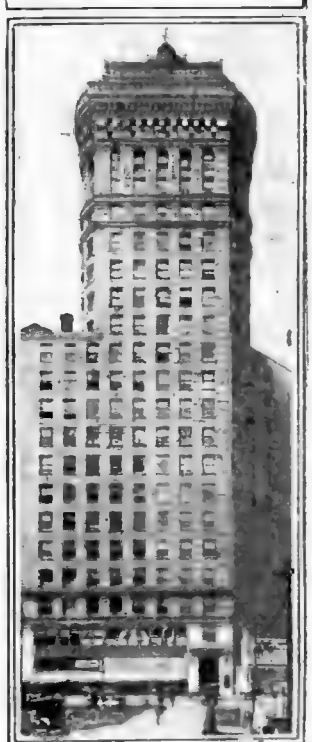

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## Tarrano the Conqueror

(*Continued from page 948*)

girl overboard. She fell into the water with a scream of laughter; came up like a mermaid and they pulled her aboard, the veils and her hair clinging to her.

At last Tarrano signified that we must go. It was upon me then to make an effort to draw back, to keep Elza and Maida at the palace with Georg and me. My heart was heavy with foreboding. Amid all this laughter and music—pleasure of the senses reigning supreme here in the Great City tonight—I could not miss a sense of impending evil. The *slaans* propelling the boats were stolid and grim. Not for them, this dalliance. Not for their women, this music and laughter, these daring costumes to display their beauty. The *slaan* women, drab with work, were slinking about unnoticed. Often I would see a boat of them slip by, furtively, in the shadows. Drab women, watching these beauties, resentful, sullen—and with what purpose smouldering in their hearts I could only guess.

The very air—to me at least—seemed pregnant with impending evil. I know that Georg felt it too. Often I had caught his eye as he regarded me. Once he started to whisper to me aside, but like a flash, Tarrano with his microphonic ear, turned to interrupt us.

I wanted to stay with Elza at the palace. Suddenly I was afraid of Tarrano, more afraid for Elza than I had ever been. And who, and what was this Red Woman? Maida knew, of course. Maida had been very solemn for hours; thoughtful; almost grim. And I had seen her lips tighten when Tarrano told Elza of the Red Woman.

And the *slaan* in the water who said he did not blame us. He had warned us to guard ourselves. But how? There were no weapons. On this night of pleasure nothing would have been more incongruous.

And that metal cap in the water with a man's face behind it? An Earth-man of my own race! What did it mean?

I was perturbed—frightened. But I did not demur when Tarrano led us to his flower-bedecked barge. Of what use?

We were paired. Georg with Maida; Elza with Tarrano. And I? Tarrano told me curtly—and with a smile of ironic amusement—that when we reached the festival so handsome a man as I would have no trouble engaging the attention of some Venus-maiden.

On cushions in the barge we reclined while our *slaans* poled us along the streets. Tarrano was feeding sweets to Elza as though they were gay young lovers. Poor little Elza! She was frightened. Her face was a trifle pale, her lips set. But she, too, knew that we were wholly in Tarrano's power, and she made the best of the situation. Sometimes she would laugh gayly; but I could not miss the note of fear in it.

The progress of our barge was slow. Boats clustered around us, their occupants pelting us with flowers. A deluge spray of perfume was turned on us—a heavy, exotic scent, almost cloying. It lay redolent on our garments for hours.

Presently Tarrano gave us masks. And long robes for Maida and Elza to cover the gay holiday dresses they were wearing.

At the edge of the city a canal had been dug through the hillside. We passed slowly through it, under archways of dangling colored lights, around a sharp bend and came upon the Water Festival. And—with impending tragedy for the moment forgotten—I gazed for this first time at such a scene of pleasure and beauty as I had never even imagined.

(*To Be Continued*)

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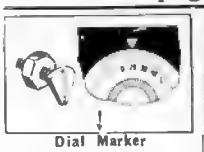

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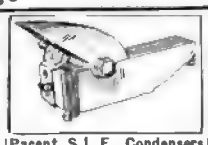

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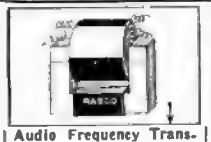

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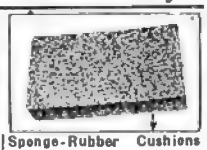

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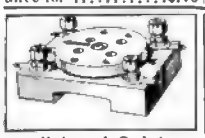

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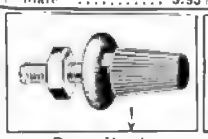

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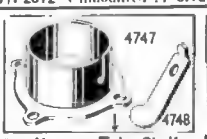

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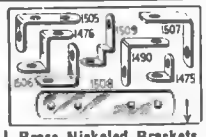

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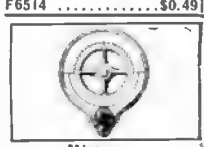

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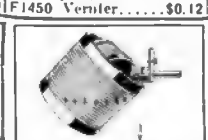

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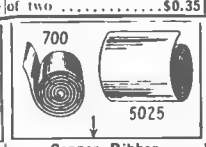


**Copper Ribbon**

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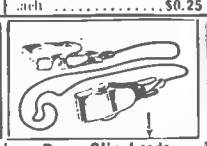
F700 ⅝" wide; F701 ¼" wide; F702 3-16" wide. All sizes per foot...$0.01

**Copper Foil**

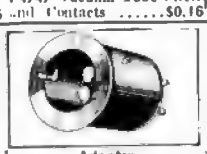
.001" thick. 4" wide.
F5025 Copper Foil, per foot .....$0.10
10-foot length ..... 0.80



**Rasco Clip Leads**

Invaluable for experimental work. Clip lead hooks in a jiffy onto any wire, binding post or conductor. Safest experimental connection. Brass clips, 1 foot silk wire, green or red.

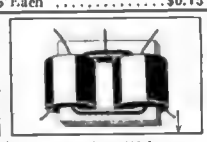
F7887 Clip Leads, ea.$0.12
Dozen lot .....1.35



**Adapter**

Pacent Improved Adapter. Takes 199-type tubes. Fits standard 201A sockets. Phosphor bronze springs, short circuits impossible. Bakelite molded.

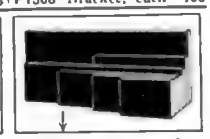
F6521 Adapter .....$0.36



**PUSH-PULL**

Push Pull Transformer for many new circuits. See any radio magazine. Made of best materials. Coils impregnated. Silicon steel laminations. Save 50 per cent by assembling yourself. Simple instructions furnished.

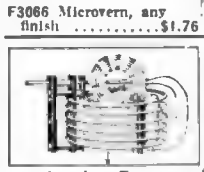
F1159 Push-Pull Transformer, ratio 6½ to 1 $2.95



**Hard Rubber Panels**

Highest dielectric strength as per Bureau of Standards. Beautiful high finish.

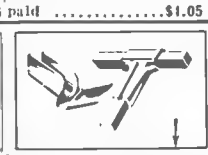
F7100 7x10x3-16" .$0.65
F7120 7x12x3-16" . 0.79
F7140 7x14x3-16" . 0.89
F7180 7x18x3-16" ..1.15
F7210 7x21x3-16" ..1.31
F7240 7x24x3-16" ..1.46



**Low Loss Tuner**

Same type as used in our LOLOS EXPLORER. Tunes from 200 to 600 meters. Hard rubber insulation throughout. Silver plated primary. Secondary D. C. C. Tickler silk insulated wire.

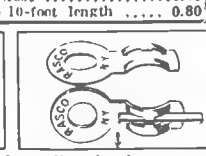
F2690 Tuner .....$5.00



**"T" Wire Connectors**

This big little article solves all troubles when making "T" wire connections. Made to take 1-16" square or round bus-bar wire. Can be attached with a pair of pliers.

F2975 "T" Wire Connectors. 12 for.....$0.10



**Nosolder Lugs**

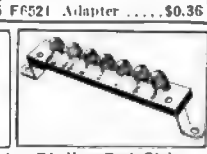
Finally, a real solderless lug is here. Soldering positively done away with. Takes square or round bus bar, which it holds with a vise-like grip. Perfect connection. Just slide bus bar into slip-grip.

F3727 Lug, 25 for $0.20

**Low Loss Coil**

Same type as used in Freshman and other Tuned Radio Frequency sets. D.C.C. wire. 200-550 wave-length. 3" diameter, 1" wide, 5-16" thick 4 connections, 2 primary, 2 secondary.

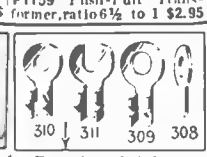
F2629 Low Loss Coil $0.43



**Binding Post Strip**

Made of hard rubber, gold engraved lettering. Two nickel brackets for mounting. 7 hard rubber binding posts. "ANT"; "GND"; "A—"; "A+"; "B—"; "DET B+"; "AMP B+".

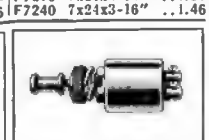
F870 Binding Posts $0.35




**Tinned Nickel Lugs**

All our lugs are tinned.

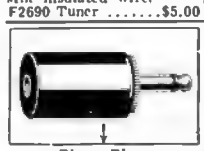
F310 Brass Lugs for No. 8 screw, doz.....$0.10
F311 Copper Lugs for Nos. 6 and 8 screws, doz.0.10
F309 Copper Lugs for Nos. 4, 6 and 8 screws, doz.0.10
F308 Copper Lugs for 6-32 screw, doz. .....0.10



**Battery Snap Switch**

This Switch is produced under high standards of workmanship. Action is positive. Solderless contact screws used. One hole mounting. Nickel-plated all over. Most serviceable switch made.

F7986 .....$0.36



**Phone Plugs**

Sold from 50c to 65c everywhere. Hard rubber composition shell and patented cord tip holder. Finest workmanship throughout.

F1030 Rasco Telephone Plug. Each .....$0.23

**Bakelite Socket**

Octagon shape. Four nickel binding posts, phosphor bronze contact springs. Best brown bakelite.

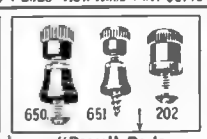
F6510 Bakelite socket $0.40

F6500 Tube Socket. Made entirely of composition. Best made. Each..$0.35

**Binding Post Name Plates**

Dia. ¾". These styles: Phones, Ground, —, Output, "A" Bat. —, "B" Bat. —, Loud Speaker, "G" Bat. —, Aerial, +, Input, "A" Bat. +, "B" Bat. +, Loop, "C" Bat. +. New! "A" Bat. + "B" Bat. —.

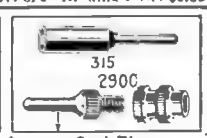
F6000 Name Plates, Dozen .....$0.15




**"Rasco" Posts**

Made of hard rubber composition.

F650-51 Each .....$0.06
F202 Has nickel plated bottom, each .....$0.06
Dozen, each style...$0.70
F122 Initialed Binding Posts. Set of 8. Per Set .....$0.25




**Cord Tips**

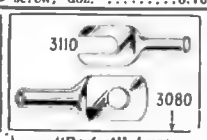
Standard phone cord tips, nickeled.

F315 Each .....$0.03

**Separable Cord Tips**

No solder required. Wire goes in ferrule. Shank holds it tight. Nickel plated.

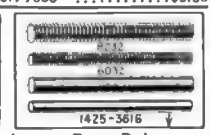
F2900 Each.....$0.06




**"Perfect" Lugs**

These new and improved lugs are brass, nickel plated, flattened on top as shown. Made of a single piece of metal. Lead wire goes into tube.

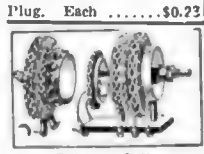
F3110, F3080 "Perfect" Lugs. Each .....$0.02
Dozen lots ..... 0.20




**Brass Rods**

Sold in 6 lengths only.

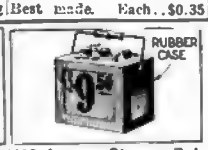
F8032 Rod 8-32" thread length .....$0.08
F6032 Rod, 6-32" thread length .....$0.06
F1425 Rod, plain, ¼" round, length .....$0.10
F3613 Rod, plain 3-16" round, length .....$0.06



**Roberts Coils**

Diamond weave coils, used in standard Roberts Circuit. Tunes 200 to 570 meters. Used in 2, 3, or 4 tube circuits. These are genuine Sickles Coils, not imitations. Set comprises two units, as illustrated.

F-8112, Roberts Coils .....$5.95




**100-Ampere Storage Batteries**

Guaranteed for two years. Only new material used. Genuine hard rubber case. Acid-proof terminals. Hard rubber vents. Strong carrying handle. Written guarantee goes with each.

F-9100, 6-volt 100-ampere hour battery ...$9.50
Shipped express collect.

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All Armstrong Circuits are explained clearly, all values having been given, leaving out nothing that could puzzle you.

Just to name a few of the circuits: The V T, as a detector and one-step amplifier; all Armstrong circuits; one-step radio frequency amplifier and detector; three stage audio frequency amplifier; short wave regenerative circuits; 4-stage radio frequency amplifiers; radio and audio frequency amplifier; inductively coupled amplifier; all Reflex Circuits.

**FREE**

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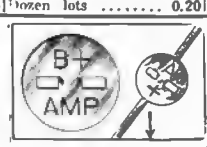
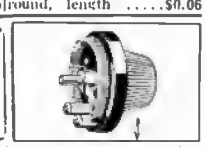



**NEW Battery Lead Tags**

Latest wrinkle, made in metal, nickel-plated, polished. Clamp tag on battery wire, and it won't come off. These five styles: "B +", "B +, Det.", "B —", "A +", and "A —".

F8030 Tags, set of 10$0.15



**Rheostats and Potentiometers**

High heat bakelite base. Come with tapered, knurled knob, 2½" dia. Complete with pointer.

F4310 6 ohm .....$0.38
F4311 30 ohm ..... 0.44
F4312 Potentiometer 200 ohms ..... 0.50

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## Can You Think Clearly?

By HARRY R. LUBCKE

(*Continued from page 902*)

(2) That a single gas contains a large number of similar molecules, another obvious assumption. (3) That molecules behave like elastic spheres. Meaning that they rebound after hitting each other like billiard balls and that no energy is lost during impact. (4) That it is possible to neglect the forces of attraction between molecules except during impact, which is to say that the molecules are so small and so far away from each other that their gravitational effect on each other is inappreciable except when they hit each other.

Now, let us take a cube of a gas one centimeter on an edge for purposes of discussion. A cube an inch on a side could just as well be taken, but since the metric system is used in science, we might as well get real *scientific* and use it also.

Let $n$ = the number of molecules in this cube (one cubic centimeter).

$m$ = mass of *one* molecule.

then $m \times n = d$ (density). In other words, the mass, multiplied by the number of molecules = density of the substance.

**Feature Articles in February "Radio News"**

Wireless Radio Dancing,
By Hugo Gernsback.

An interesting method of providing music that will mystify the dancers.

The Autoregenerator,
By Sylvan Harris.

Special Cathode-Ray Oscillographs.
By Dr. C. B. Bazzoni.

The "Peanut" Super,
By Morris Levy.

Awards of the $300 "What's Wrong" Contest.

A Balanced Reflex Circuit,
By L. W. Hatry.

Also let $V$ = volume

& $\overline{V}$ = the average velocity (speed) of the molecules.

Now it is very safe to assume that, referring to the picture of our cube in Fig. 1, ⅓ of the molecules are going in the "X" direction (therefore ⅓ n.); that ⅓ n molecules are going in the "Y" direction; and that ⅓ n molecules are going in the Z direction because of the great number of them.

Let us take just one side of the cube, say the side in the "X" plane, and consider a molecule in it. The momentum of a body is equal to its mass times its velocity therefore to $m\overline{V}$. Now, if a molecule, say "a" in Fig. 2 (which is the "X" side of the cube) hits the side of the vessel and stops it has lost its momentum $m\overline{V}$. Since we have assumed it is perfectly elastic and bounces away in the opposite direction with the same speed, the *change* in momentum will equal $2m\overline{V}$.

We said that the velocity of the molecule was $\overline{V}$, and since it is one centimeter from one wall to the other in the cube, it will take $\frac{1}{\overline{V}}$ seconds for a molecule to cross this space.

This is because distance (in this case 1 cm.) divided by velocity ($\overline{V}$) equals time. (Thus, if you went 50 miles at a speed of 25 miles per hour, it took you 2 hours;

(*Continued on page 958*)

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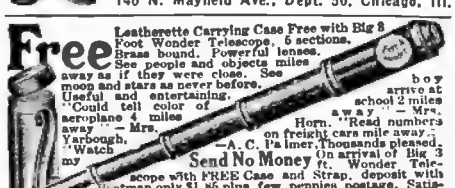

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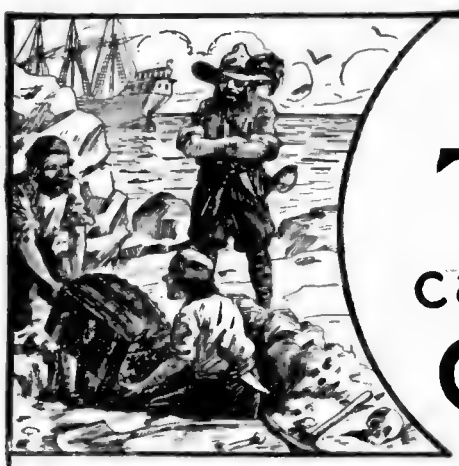

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Do you remember how the tales of pirate gold used to fire your imagination and make you want to sail the uncharted seas in search of treasure and adventure? And then you would regret that such things were no longer done. But that is a mistake. They *are* done—today and everyday—not on desert islands, but in the chemical laboratories throughout your own country. Quietly, systematically, the chemist works. His work is difficult, but more adventurous than the blood-curdling deeds of the Spanish Main. Instead of meeting an early and violent death on some forgotten shore, he gathers wealth and honor through his invaluable contributions to humanity. Alfred Nobel, the Swedish chemist who invented dynamite, made so many millions that the income alone from his bequests provides five $40,000 prizes every year for the advancement of science and peace. C. M. Hall, the chemist who discovered how to manufacture aluminum made millions through this discovery. F. G. Cottrell, who devised a valuable process for recovering the waste from flue gases, James Gayley, who showed how to save enormous losses in steel manufacture, L. H. Baekeland, who invented Bakelite—these are only a few of the men to whom fortunes have come through their chemical achievements.

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I have not written since I received the big set. I can still say that it far exceeded my anticipations. Since I have been studying with your school I have been appointed chemist for the Scranton Coal Co. testing all the coal and ash by proximate analysis. The lessons are helping me wonderfully, and the interesting way in which they are written makes me wait patiently for each lesson.—MORLAIS COUZENS.

I wish to express my appreciation of your prompt reply to my letter and to the recommendation to the General Electric Co. I intend to start the student engineering course at the works. This is somewhat along electrical lines, but the fact that I had a recommendation from a reliable school no doubt had considerable influence in helping me to secure the job.—H. VAN BENTHUYSEN.

So far I've been more than pleased with your course and am still doing nicely. I hope to be your honor graduate this year.—J. M. NORRUS, JR.

I find your course excellent and your instruction, truthfully, the clearest and best assembled I have ever taken, and yours is the fifth one I've studied.—JAMES J. KELLY.

From the time I was having Chemistry it has never been thus explained to me as it is now. I am recommending you highly to my friends, and urging them to become members of such an organization.—CHARLES BENJAMIN.

I shall always recommend your school to my friends and let them know how simple your lessons are.—C. J. AMDAHL.

I am more than pleased. You dig right in from the start. I am going to get somewhere with this course. I am so glad that I found you.—A. A. CAMERON.

I use your lessons constantly as I find it more thorough than most text books I can secure.—WM. H. TIBBS.

Thanking you for your lessons, which I find not only clear and concise, but wonderfully interesting. I am—ROBT. H. TRAYLOR.

I received employment in the Consolidated Gas. Co. I appreciate very much the good service of the school when a recommendation was asked for.—JOS. DECKER.

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## Can You Think Clearly?

(*Continued from page 956*)

$\frac{50}{25} = 2$). Now if it takes $\frac{1}{\overline{V}}$ seconds to go across, it will take $2 \times \frac{1}{\overline{V}}$ sec. to go across and come back, hence $\frac{2}{\overline{V}}$ seconds between *consecutive* impacts. The number of impacts per second equals the time required for one impact $(\frac{2}{\overline{V}})$ divided into one second, or $\frac{1}{\frac{2}{\overline{V}}} = 1 \times \frac{\overline{V}}{2} = \frac{\overline{V}}{2}$ Hence the change in momentum, per second, equals $2m\overline{V} \times \frac{\overline{V}}{2} = m\overline{V}^2$, for we have a change in momentum of $2m\overline{V}$ for one impact and there are $\frac{\overline{V}}{2}$ impacts per second.

Now, see all that we know starting from a few simple ideas and symbols. Don't weaken, the end is in sight.

## THE LATEST HOBBY
## $5,000.00 For Models

**Models made of match sticks are simple in construction, inexpensive to make and may win for you part of the $5,000.00 that SCIENCE AND INVENTION Magazine is offering for this work. See the article in this issue and also December for complete details.**

If you are confused, read the above over again.

To continue:

$m\overline{V}^2$ = the average force exerted by 1 molecule on the side of the container.

$\therefore \frac{1}{3} n m\overline{V}^2$ = the average force exerted by all molecules moving in "X" direction, but $\frac{n}{3} = d$, therefore:

$\frac{1}{3} d \overline{V}^2$ = the average force exerted by all molecules moving in "X" direction.

This force is exerted on one square centimeter, which is the unit of area, and since force per unit area equals pressure;

$P = \frac{1}{3} d\overline{V}^2$ where P = pressure multiplying by V (the volume)

$$PV = \frac{1}{3} dV \overline{V}^2$$

Now the mass of a substance equals the mass per unit volume (density) times the volume; or $M = dV$ where M = mass of substance.

Substituting M for dV in

$$PV = \frac{1}{3} dV \overline{V}^2$$

we have

$$PV = \frac{1}{3} M \overline{V}^2$$

Now, the mass (M) of a given quantity of gas is constant. The average velocity of the molecules of a gas is constant if the temperature is constant. (This is Charle's Law, another aspect of the kinetic theory.)

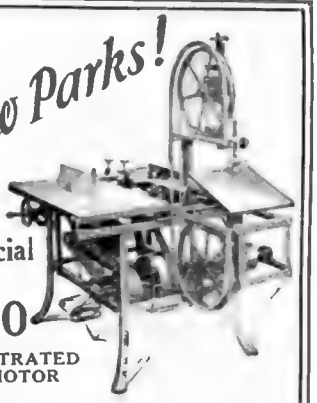
Therefore, since *all* the quantities on the right hand side of the equation are *constant*, they can be "C."

Hence PV = C.

Which was what we set out to prove.

A little muddled? Well, this is to be expected the first time. Now read it over once more, or perhaps twice, and see how everything clears up.


# A new Parks!



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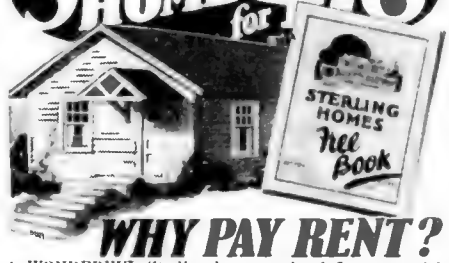
PARKS
WOODWORKING MACHINES



# 5 ROOM HOME for $478

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## The Light Beam Piano

By A. P. PECK

(*Continued from page* 897)

a nearby table. In appearance it resembled an ordinary phonograph with an extraordinary reproducer attached to the tone arm. Used in connection with this instrument was a standard resistance coupled audio frequency amplifier and a loud speaker. Obviously, the reproducer was electrical in operation and such proved to be the case upon investigation. Within the casing is a Rochelle salts crystal which has been found to have some very peculiar electrical properties when subjected to physical compression or torsion. It becomes a generator of alternating current under such conditions and this feature has been pressed into service to act as a phonograph reproducer. As far back as the December, 1919, issue of this magazine we published an article dealing with such "speaking crystals," and even showed a proposed system for producing phonograph records with these crystals. Our illustrations in Figs. 6, 7 and 8 show, respectively, a photograph of the Crystaphone, as this reproducer is called, a detail of a Rochelle salts crystal reproducer such as described in the issue of this magazine mentioned above.


IMPORTANT

TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly, every month. If you are interested in receiving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

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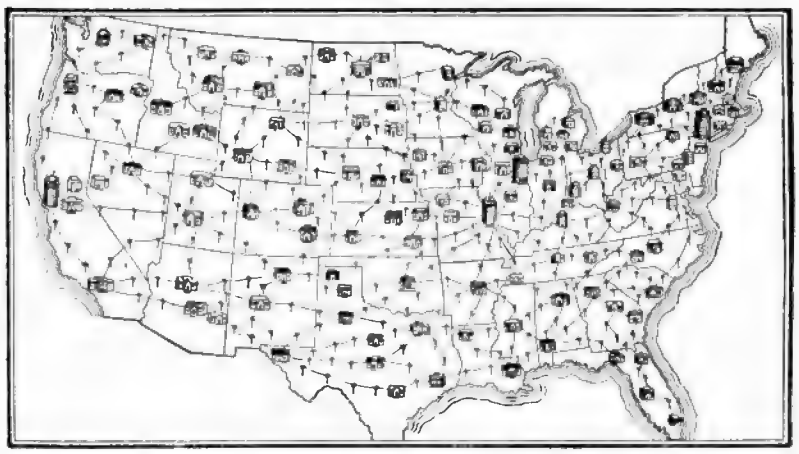
and a circuit of the reproducer, its audio frequency amplifier and the loud speaker. Demonstration of this apparatus proved that the device surely lived up to its name, as the reproduced music was literally as "clear as crystal" and practically free from all extraneous mechanical sounds, such as the usual scratching of the phonograph needle on the record. Although this system of reproduction is not radically new in theory, still Mr. Matthews has reduced the system to practice and has produced a working model of a crystal phonograph reproducer that gives most satisfactory operation.

All the time that we had been present in this laboratory, our eyes had wandered occasionally toward the far corner where, reposing upon two brackets, stood a queer looking model of a boat. A photograph of this is shown in Fig. 9. As soon as other demonstrations were over, we promptly proceeded to ask some questions about this boat and learned that it was designed to be controlled by means of a beam of light. Mr. Lynes told us that the boat had been controlled over a distance of five miles with very great success. Proceeding to the side of the boat, he closed two or three small switches and

(*Continued on page* 961)

# *The Future of the Telephone*

IT WAS fifty years ago that Alexander Graham Bell invented the telephone, and yet this anniversary is but a milestone in the progress of telephone development. As the giant oak with its complicated structure grows from the acorn, so a nation-wide system has grown out of Bell's single telephone instrument.

The interconnection of millions of telephones throughout the land, regardless of distance, has not come about easily. It has resulted from a series of scientific discoveries and technical achievements embodied in a telephone plant of vast extent and intricacy. Great economies have already been gained by such technical improvements and more are sure to follow for the benefit of telephone users everywhere.

There are still to come many other discoveries and achievements, not only in transmission of speech, but also in the material and construction details of every part of the network of plant.

The future of the telephone holds forth the promise of a service growing always greater and better, and of a progress—the end of which no one can foresee.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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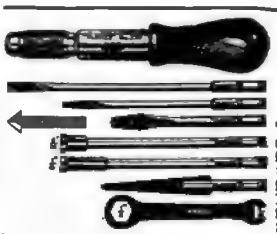
### AERIAL OUTFIT

Complete aerial outfit for the RADIOGEM, consisting of 100 ft. of standard copper aerial wire and two special porcelain insulators. Price .....50c.

**Radiogem - - - $1.00**
**Aerial Outfit - - - - .50**
**Radiogem and Aerial Outfit - - - - 1.50**

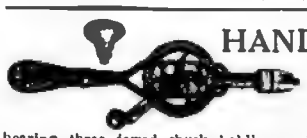
# RAGEMCO

## Radio Headquarters for the Finest and BEST Radio Tools



### RADIO TOOL SET

This is the handiest set of tools ever made for Radio Work by the makers of the famous "YANKEE" Tools. It contains the following: 1 Rachet Screw-driver, 6½ in. long, holding all attachments; 1 Blade, 5½ x 3-16; 1 Blade, 3½ x ⅛; 1 Blade 2½ x ¼; 1 Countersink; 2 Socket Wrenches for all small nuts; 1 Reamer to enlarge holes in panel from ⅛ x ½; 1 Wrench, one end 5-16" square or hex. for jack, other ¼" hex., etc.
**PRICE per set—No. 701 .....$3.00**



### HAND DRILL

The hardwood handle is hollow to store drills. Iron frame, nickeled parts, ball bearing three jawed chuck holding and centering accurately round shank drills from 0 to 3-16. Length of drill, 12 inches.
**PRICE—No. 303 .....$2 25**

### WIRE BENDING TOOL

For making eyes, loops, bends, and offsets on Bus Bar wire. With this device any Radio Constructor can wire his set to compare favorably with any factory made set. Easier to use and more accurate than pliers. Full directions in box. Made of heavy steel, blued and finished.
**PRICE—No. 203 .....$1.00**

### CIRCLE CUTTER

Especially designed for the Radio Constructor. Made of the finest material and equipped with the highest grade high steel cutting bits. It does three things at once. It drills its own pilot, cuts out plug and puts bead or scroll around the hole in one operation. Cuts holes ¾ to 4 in. in diam.
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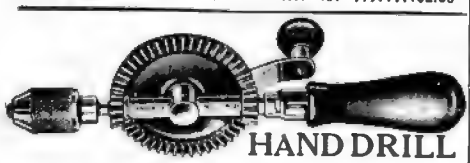
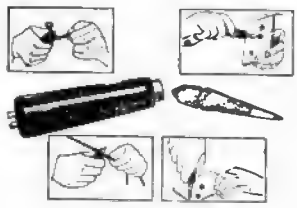


### HAND DRILL

Especially designed for Radio Work by the makers of the famous "Yankee" Tools. A beautiful balanced, small, powerful drill with 4 to 1 ratio of gears for speed. Special chuck 0-32" capacity, to take largest drill, mostly furnished with drill or tool sets. Length over all, 9½ in. Weight 1½ lbs.
**PRICE—No. 302 .....$2.75**

**Three-in-One Nut Wrench.** Consists of handle with hollow stem 6 inches in length and three interchangeable sockets fitting popular sizes of nuts. The hexagon sockets grip the nut solidly.
**PRICE per set—No. 301 .....65c**

**Side Cutting Nipper, Lap Joint.** For cutting all kinds of wire. Jaws hardened and oil tempered. Natural steel finish with polished jaws. Length 6 inches.
**PRICE—No. 201 .....75c**



### RADIO HANDI-TOOL

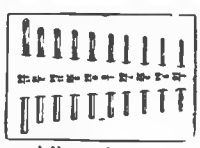
Bends Bus Bar or wire strips and scrapes wire, bores and reams holes, etc. Tool consists of 4 in. black japanned handle, to which is attached wire bending device, with nickeled ferrule and 3 in. long two sided reamer.
**PRICE—No. 702 .....50c**

### TOOL CHEST

Set consists of "LOCK-GRIP" master handle, 5" long, black Rubberoid finish with steel chuck, nickel plated, buffed and with the following 9 tools: Saw, bradawl, large screwdriver, file, scratch awl, gimlet, reamer, chisel, small screwdriver. Each tool of fine steel, drop forged tempered, hardened, and nicely finished. Set comes in leatheroid box with tray.
**PRICE—No. 703 .....$1.85**

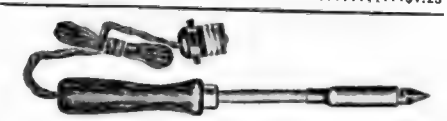
### SCREW STARTER and DRIVER

Holds any screw by its slot with a firm grip, makes it easy to place and start screws in difficult places. Just the tool for the Radio Constructor. All parts heavily nickeled and polished.
**PRICE—No. 304 .....$1.00**



### RADIO DRILL SET

Composed of 10 straight shank twist drills, fitting all hand and breast drills. The selection of these drills has been especially made for Radio Constructors and consists of the following sizes: 1-16, 5-64, 3-32, 7-64, ⅛, 9-64, 5-32, 11-64, 3-16, 17-64. Drills are mounted on white Holland Linen with sizes clearly marked.
**PRICE—No. 305 .....$1.25**



### ELECTRIC SOLDERING IRON

A perfect tool for Radio Work. Operates either on 110-volt A.C. or D.C. The heat element is of Nichrome, which prevents overheating and assures the desired even temperature. Size of Iron, 10½ in. long. A 4-ft. cord and plug is furnished.
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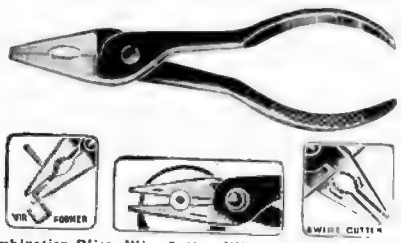
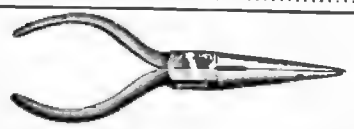


**Combination Plier, Wire Cutter, Wire Former and Wrench.** Drop forged, slender but exceptionally strong. 6 in. long.
**PRICE—No. 202 .....75c**



**Long Sharp Nose, Side Cutting Pliers.** Just the pliers for the radio constructor. Bends and cuts all kinds of soft wire. Nose 1½ inches long, black body, polished jaws. Length 5½ inches.
**PRICE—No. 200 .....75c**

Order all tools by order number. All goods are shipped free of transportation charges to all parts of the United States and possessions the same day as the order is received.

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*If you are not satisfied money will be refunded on return of goods.*

## The RADIOGEM CORP., 66-S W. Broadway, New York

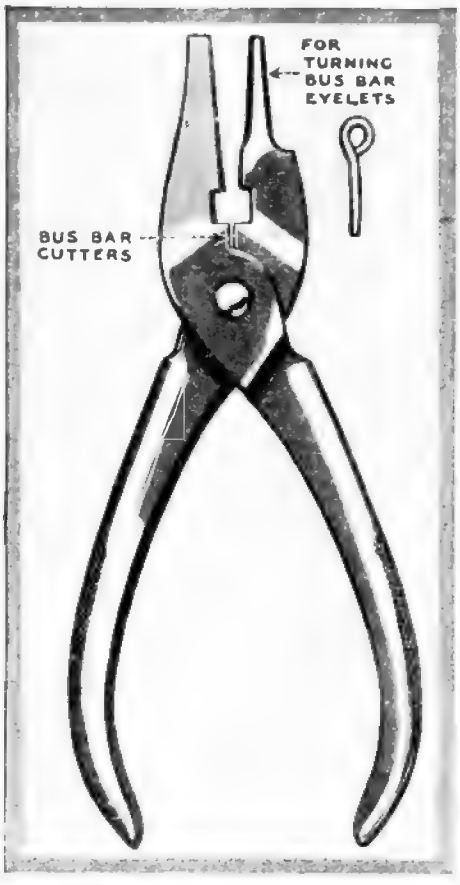
## The Light Beam Piano

(*Continued from page 959*)

then walked to another corner of the laboratory and turned on a 1,000-watt searchlight equipped with a shutter. Directing the beam toward the small tower in the center of the boat which contained a selenium cell, things began to happen. The propeller at the rear of the boat whirled around with great rapidity and a white light at the top of the central tower shone forth. Closing the shutter and opening it again, a click was heard and the small rudder shifted to one side. Simultaneously, a red light shone forth. Again flashing the light, the rudder came back to a straight-forward position and the only light visible was the white one. The next flash caused the rudder to turn to the other side and a green light was seen. The next impulse of light caused the gun to be fired and the last one brought the boat to a full stop. A series of selective and progressive relays indicated in the diagram in Fig. 10 caused all these actions to take place. Every part of the boat was electrical in operation and was controlled through the medium of one selenium cell mounted in the tower. A study of Fig. 10 will show the reader just how everything happened.

And aside from these novel and interesting things that Mr. Matthews has developed, he has one or two other schemes under way upon which we hope to present details to our readers in a near future issue. For instance, with one of his devices he hopes to be able to project advertisements in colors upon clouds at night. This should be startling and spectacular in the extreme. Mr. Matthews has also designed and developed a system of talking motion pictures in which the voice is in absolute synchronism with the picture and in which a special lamp is used to impress the voice record on film.

### EYE-FORMING PLIERS




With this tool, eyes can be readily made in bus bar or wire. It is very handy when constructing radio sets.

*When this dredge started work the Mayor of Nome, Alaska, declared a holiday and all of the inhabitants attended.*


# The "Forty-Niner" of '26

Massive electric dredges now mine Alaskan gold. At almost incredible temperatures they dig 60 feet deep and scoop out 200,000 cubic yards a month.

From the Arctic regions to the Equator, G-E equipment is called upon to perform many hard tasks once done by hand but now better done by electricity.

General Electric supplied all electrical equipment for two such dredges now operating at Nome. A Diesel-electric power plant, four miles distant, furnishes the energy for a total of 592 h.p. in electric motors for each dredge.

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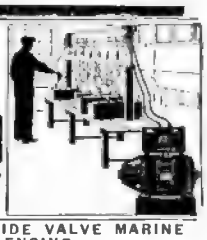

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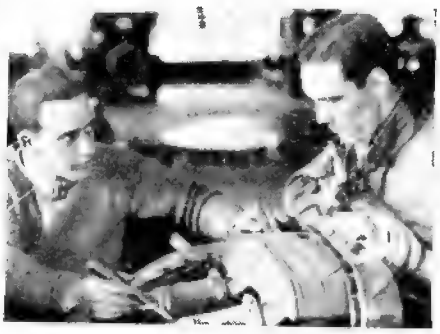

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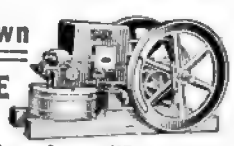

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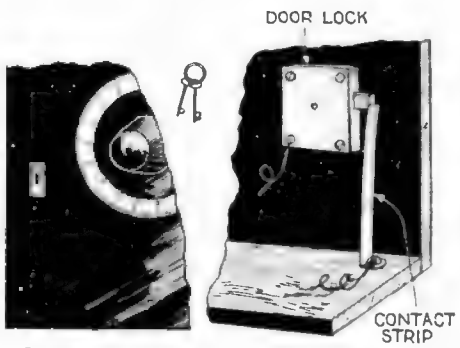
## RADIO WRINKLES

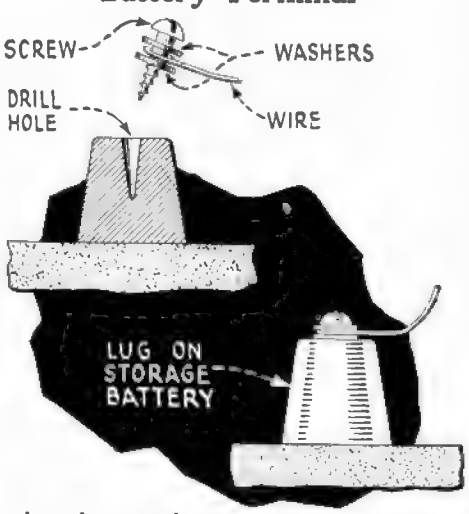
UNDER this heading we are going to publish items of interest to everyone who likes to build radio instruments. In order to continue this department it is necessary for our readers to tell us about their latest experiments. Write us a short description of some time- or money-saving kink you have discovered and send it to us along with a few sketches. Our regular rates will be paid for this material. Be brief and try to put everything in the drawing. Don't be too elaborate. Address "RADIO WRINKLES" Editor, care of SCIENCE AND INVENTION.

### Lock




If an ordinary door lock is obtained and fitted to the back of the panel as shown directly above, an "A" battery switch that can be locked either open or closed is made.
—Richard Bramhall.

### Battery Terminal




A good way to fasten connections to storage battery terminals is to drill and ream out a tapered hole in the lead lug and then drive an ordinary wood screw into it. Two washers are placed on the screw between which the connection wire is to be clamped.
—William L. Bloom.

### Charge Cabinet

When a radio experimenter is using a storage "B" battery and a charger for the same, the two units are often left lying around in any position that they happen to fall. If, however, the idea used by one manufacturer and illustrated above is used, there will be no more broken battery jars and other similar troubles. The idea is to incorporate both the battery and the charger within one cabinet and provide a charge—discharge switch.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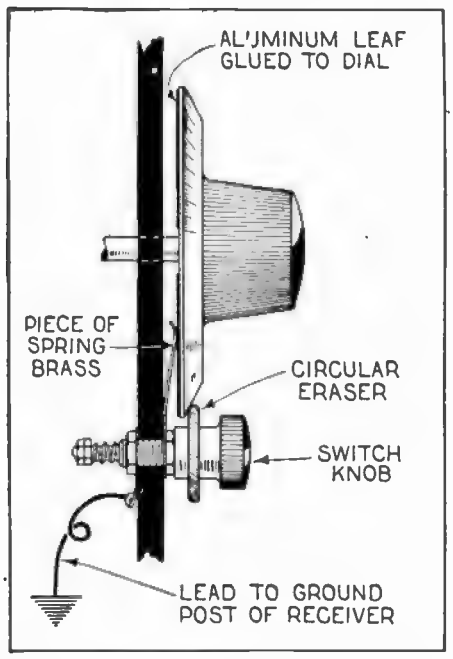
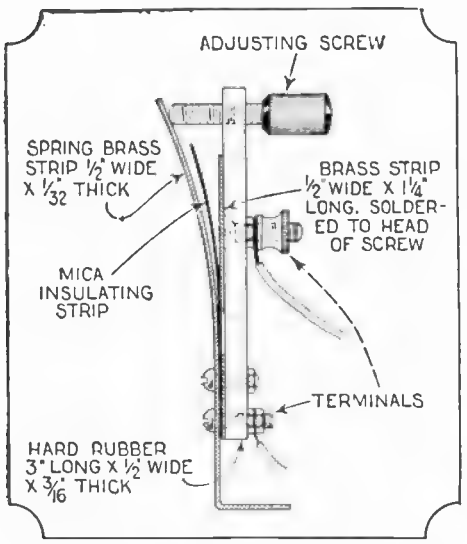



If a circular piece of foil is pasted onto the back of a dial, there results a very good shield that is excellent for preventing body capacity. Contact to ground is made by using a short length of spring brass. —Abe Dolid.

## NEUTRALIZER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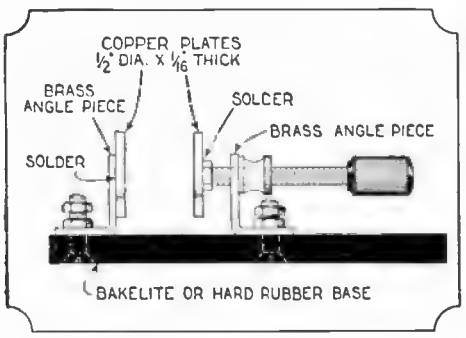
SPRING BRASS STRIP ½" WIDE X 1/32" THICK
BRASS STRIP ½" WIDE X 1¼" LONG. SOLDERED TO HEAD OF SCREW
MICA INSULATING STRIP
TERMINALS
HARD RUBBER 3" LONG X ½" WIDE X 3/16" THICK

In order to eliminate waste of energy such as is bound to occur when using neutralizing condensers, a much better one which can be mounted on the grid terminal of the socket, is shown above. It is also a splendid grid condenser. —Glen McWilliams.

## ANOTHER NEUT.




The experimenter who is constantly improving and modifying his circuits, would do well to construct the neutrodon in the manner shown above. The device can also be used as a miniature spark gap. —Harry Mulder.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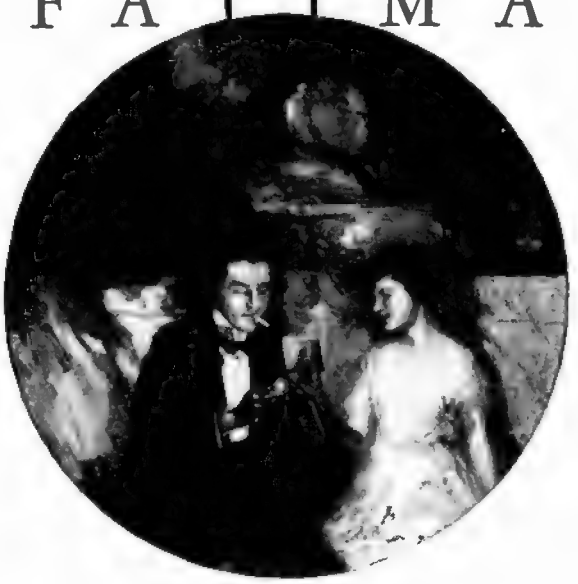
"LET ME SEE something better," says the customer—very frequently indeed. That something better in an automobile may cost several hundred or perhaps even several thousand dollars more; but in a cigarette it costs just three cents more

FATIMA



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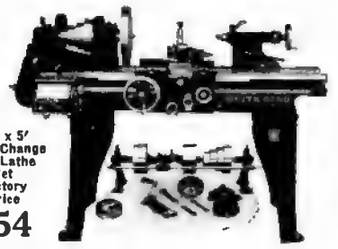

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## Artists of the Microphone

By CHAS. D. ISAACSON

(*Continued from page 952*)

facts about their favorites. The book is going on the newsstands at 25 cents a copy, but I have persuaded the publishers of RADIO NEWS to let me give a copy of this to anyone who writes to me before February 15, at the Roosevelt. So, if you have not had a copy, ask for it at once.

### DIGEST OF THE MONTH

In additon to the appearance of the grand and light opera companies in their regular performances of the classics, every one of the feature artists at WRNY has had one to four appearances during the month.

Ben Bernie's and Orlando's orchestras at the Roosevelt have had their orchestras on the WRNY platform frequently.

The Radio Theatre Players, under the direction of Alfred Rigali, have presented "Nothing But the Truth," "Bought and Paid For," "Her Husband's Wife" and "Civilian Clothes."

The Radio Art Players, under the direction of Mr. V. P. Newmark, have been heard in Moliere's "Affected Young Ladies," Chekhov's "The Boar" and Shakespeare's "Taming of the Shrew" and "The Merchant of Venice."

Harvey Wiley Corbett has brought such men as Grosvenor Atterbury, Professor William Dinsmore and Alfred C. Bossom.

The Women's Hour has taken big form.

The Novelty Night Features on Friday nights are among the most popular in the radio field. There was one night that Mental Telepathy was the feature and you should have heard the calls and seen the letters from the listeners that the telepathic idea had actually gone across. People caught our thoughts. Then there was the Old German Band Night, and how everyone roared over it! "Superstitions" was an unusual feature on Friday the thirteenth. There was a repetition of the Spiritualistic Seance. There was the Simultaneous Musicale that A. Russ Patterson broadcast with a company of artists, and the program was simultaneously sung in hundreds of homes, churches and schools.

Then there was the Aviation Banquet, which was given at the Roosevelt, and which was broadcast by this station through Tom Hill, President of the American Society for the Promotion of Aviation, Inc.

There were many distinguished guests, among whom might be mentioned the Hon. Fiorello La Guardia, General William Fechet, Colonel Bishop, Colonel H. E. Hartney, and many more.

One day in the grill room of the Roosevelt, a unique picture was the sight of two hundred choir singers under the direction of Dr. Morgan, on the very spot where people dance to the music of Ben Bernie, and Dr. Millar delivering his sermon in the spot where Ben Bernie hands out his wise cracks.

The Up and Down Broadway feature has been a knockout all the way through. Among the companies that have appeared this month have been "Laff That Off," "Dearest Enemy," "Twelve Miles Out," "Earl Carroll's Vanities" and "The Florida Girl."

Every day at WRNY is packed full of excitement and interest.

P. S.: Charles D. Isaacson's Concerts at De Witt Clinton Hall, Tenth Avenue and 59th Street, and broadcast through WRNY, are quite the event of the air. Every Sunday night WRNY's program director and his associate assistants appear at De Witt Clinton Hall. The concerts are free of charge and from a thousand to fifteen hundred people are always in the audience.

## Portable Radio Laboratory

By RAYMOND HERCHERT

(*Continued from page 935*)

for use as intermediary frequency or radio frequency amplifiers.

To rejuvenate vacuum tubes of the 201A type, adjust the filament voltage to 22 volts and run for 20 seconds. Then reduce the filament to 6 volts and run for 15 minutes. Both of these operations should be carried on with the "B" battery turned off. For tubes of the UV-199 type, use first 10 volts and then 4 volts.

This set of instruments can also be used as a wave-meter by calibrating the tuning condenser, C1. To do this, connect the set to an antenna and ground and listen in on the headphones. Log the stations received and make up a chart from the log so obtained. Plot dial settings against the wave-length of the stations and you will have a calibration curve for your oscillator.

To test fixed condensers for capacity, insert the condenser under test in the clips shown in Figs. 2 and 3 and note the reading on the meter A. This is done with switch S on the left-hand point. Now change the switch to the right-hand point and vary the tuning condenser until the meter A reads the same as before. Refer to the capacity curve of your particular condenser and you will find the capacity of the fixed condenser indicated by the setting of the variable condenser. It is obvious, of course, that only fixed condensers whose capacities lie within the range of the variable condenser can be tested.

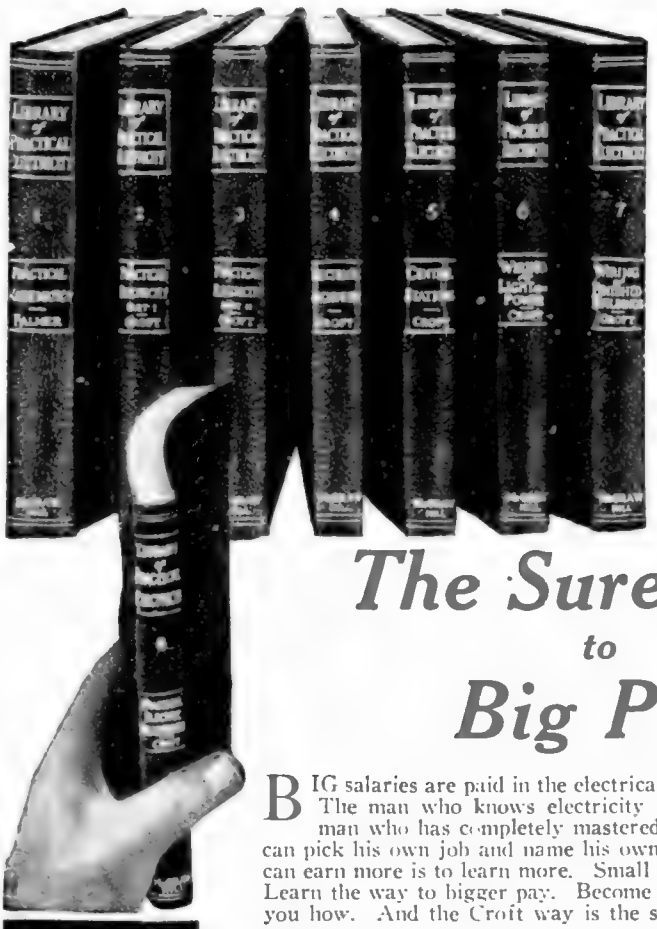
To test for an open circuit, attach two long wires to binding posts 1 and 2. These two posts are normally shorted by a jumper during operation. Remove the jumper in this instance and touch the other ends of the long wires to the instrument to be tested. When a continuous circuit is present, the volt-meter V1 will read, providing, of course, that switch S2 is on a "live" switchpoint.

To test external batteries, remove the vacuum tube from the socket, and set switch S2 on a "dead" switchpoint. Connect the battery to binding posts 1 and 3 and read the voltage on the volt-meter V.

The volt-meter V1 is in the circuit for the purpose of checking the voltage of "B" batteries and it can be used for determining the value of those batteries contained in the portable laboratory or for measuring other batteries. In the latter case, attach two long wires to binding posts 4 and 5 and connect the other ends of the wires to the batteries to be tested. Read the values on the volt-meter V1.

It is obvious that with this type of assembly many things are possible and in its present form with the various switches it is quite flexible. By varying the switch S2, different filament voltages can be obtained and the same applies to the "B" battery voltages with S3.

The buzzer shown in the diagram in Fig. 2 is for the purpose of modulating the output of the oscillator when the same is used as a wave-meter for checking the wave-length range of non-regenerative vacuum tube receivers or crystal detector receivers. For regenerative sets, the oscillator alone can be used, but the pure C.W. wave generated by it will not register on a non-regenerative or crystal set. Therefore, the oscillations are modulated by the buzzer. As indicated in the diagram, the buzzer is operated by 1½ volts. Some buzzers require a slightly higher voltage and this will have to be found by experiment.

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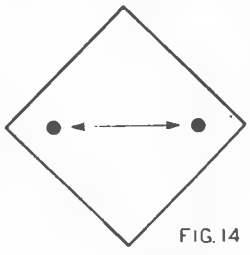
## Optical Illusions

By DR. WALTER EHRENSTEIN

(*Continued from page 907*)

were identical portions of the lines, which phenomena are shown us by the actual movement of the diagram, various movement phenomena between various portions of the angular outline appear and affect successively different portions of the retina, so that during the movements the angle seems to spread. These movement phenomena we can designate very properly as intrafigural apparent



The dot in the angle of the square seems to spring from one side to the other when properly viewed.

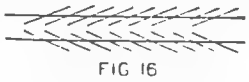
FIG. 14

movements, because their rôle between various portions of the same figure is a sort of subjective movement. The magnitude of the changes in the case of small angles is very considerable, until an expressed maximum of twenty-five degrees is reached, and then it slowly falls away, disappearing at 60 degrees.

These intrafigural (as the author calls them), apparent or subjective movements, can be demonstrated by logarithmic spirals of the angle of highest degree of change, Fig. 7. In the case of this spiral, a strong increase or diminution of the distance between the spiral can be seen during the rotation, according in each case to the direction of turning. But more than this, after the rotation has ceased, the eye seems to see after its excitation by this rotation, for a considerable period even up to twenty-eight seconds, the opening and closing of the spiral which it seemed to see during the period the rotation was impressed upon the retina. Again if one shuts one eye during the rotation of the spiral, the after image, as we may term it, affects the unexcited or closed eye! A very surprising appearance, yet one to be explained by intrafigural illusions are the characteristic movements of eccentrically placed circles which very beautifuly produce the effect shown in Figs. 8, 9, 10 and 11 when rotated.

How these intrafigural movements have to do with optical illusion we will immediately recognize if we have brought into consideration the contrast at proximity. On the occasion of a heavy snowfall Mach's little daughter spoke in bewilderment to her father, saying that it seemed to her that she was constantly riding up into the air. Mach then had a series of stripes which were black and white and of even width prepared upon a long cloth, wound upon one of two rollers, and then moved up and down. An observer standing in front of the striped cloth received the impression that an object standing motionless against the same, often the entire surrounding of the cloth, along with his own body sometimes sank down and sometimes rose up, according to whether what we may call the Mach curtain, moved up or moved down. With this curtain the contrast was carried out by objective movements, but this is not all.

What are called *tachistoscopic* movements sometimes follow. The *tachistoscopic* movement is a movement by which an object,



Here again appearance of parallel lines is seemingly changed.

FIG. 16

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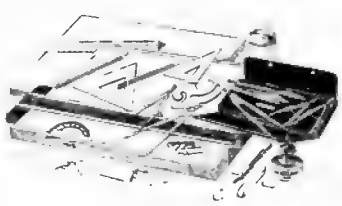

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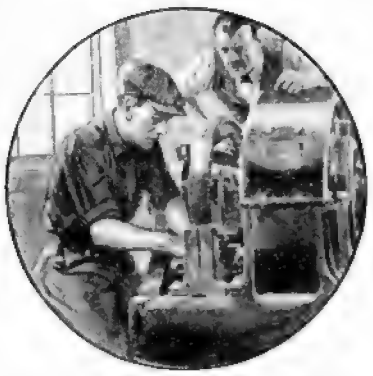

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such as a line, is brought in front of the eye and then after a brief interval a second line is brought into the neighborhood of the first. Then one sees the continual movement of an identical line from one place to the other (principle of cinematographic vision). If one changes a point P with a horizontal line, a, above it with another point in the same place and with another line, b, a little ways below it, Fig. 12, one sees not only a back and forth movement from a to b, but also a very clear contrast movement of the point whose location in the objective or real space remains absolutely unchangeable.

More striking still is this contrast movement if as before in the two exposures we have a point in the identical place in objective space, but which on one exposure is seen in the left corner and the other in the right corner of a diagonally placed square, the back and forth movement of the square is often unobservable, while the objectively motionless point, which is really fixed in position, seems to spring from one angle to the other of the square as shown in Fig. 14.

The movement contrast in both these experiments assuming the effect of a movement of the point takes place when the intrafigural movement occurs in the angles of the diagram and even when these are not observable. If we move very rapidly in the proper way, a point location towards an angle (the angle must be drawn upon glass or tracing paper). The observer will see how the distance of the point constantly increases. A point which crosses the diagonal line in a horizontal direction follows in our perception

The dotted parallel lines appear to converge due to the crossing of the solid lines.

FIG 15

a curved path, which departs the more from the horizontal direction, the closer the point comes to the line; in other words, the more it is subjected to these intrafigural movements.

Now if we look at Fig. 15 we see that the parallel lines there drawn depart from their objective or actual direction, and so much the more, the closer they approach the intersection of the other two lines, and are exposed to the influence of intrafigural illusion. These parallel lines in the vicinity of the point of intersection appear oppositely affected to the inclination of the diagonal lines. What we observe in this figure we find to be an angle illusion again. The classic example is a complicated reproduction of the simplest case given in Fig. 15. In Fig. 15 we have one out of the many crossings given in Zoellner's classic, Fig. 16, and these lines are affected just as the parallel lines are in Fig. 15, and the divergence of the short lines brings about an apparent convergence of the parallel lines.

By all investigators the action of eye movements in the above illusion is always observed as a strengthening or intensifying effect. This explanation of the angular illusion by intrafigural appearances finds its most impressive support in the fact that the maximum effect or illusion is observed at the same angle (13°) at which the *optimum* or best results for the intrafigural movement are found. We can in any case simplify the requirement by substituting a single cross line in Zoellner's figure for the two horizontal lines always given—*Die Umschau.*


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By R. A. CHATH

(*Continued from page* 923)

may be made from almost any scraps of spring brass you happen to have lying about. Cut them to the size indicated in Fig. 12 and round off the edges with a file. Now all is complete except assembling. Fig. 23 shows how the parts should look.

Almost everybody knows how to hitch up

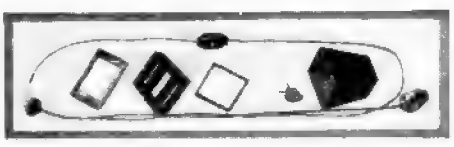
In the photograph above, the various tools that were employed in building this photograph enlarger are illustrated. Fig. 2.

an electric light wire, so we won't go into details on this score, except to state that the push-button switch should be placed in the middle of the cord. By the way, don't under any consideration use a key, pull chain or bush-button socket. If you do, you'll find that, sooner or later, when making a grab for the key, you'll joggle the whole works and get an impressionistic, soft focus print not entirely to your liking.

Got the cord all hooked up? All right; now screw the socket into the lamp house and then insert the bulb. Cover the open end of the house with a sheet of cardboard and turn on the current. If there are any holes in the joints, this will show them up. If you do find any, an application of black paint around the spot will cover them.

Next, gently drop the opal glass diffuser into its place in the rear, or frame 19 side of the body; set the lamp house on top of it and secure with the retaining hooks, screwing them down until they rest snugly against the wire projections. Finally, slip the negative glasses into the carrier and screw fast the clips with the ¼-inch round-head screws so that the free ends of the clips are in the center of the depressions at the ends of the carrier.

Now, if your camera doesn't happen to have a back adaptable to plates, you can rig up this attachment for it with very little additional trouble. In practically all cameras the back is either hinged or may be entirely removed for loading purposes. If it is hinged, the only thing necessary is to drop the door down and build the front or No. 15



Here we show the essential parts of the photo enlarger, unassembled and laid out for inspection. Note type of bulb used. Fig. 23.

frame to fit the opening. The attachment may be secured to the camera by strong elastic bands, cord or small brass hooks. If the whole back comes off, as is the case in many roll-film cameras, order an additional back piece from the makers. On the outside of this back, lay off a rectangle exactly the size of the opening in the adapter body. Drill a small hole in each corner of the rectangle and with these as a start, cut out the oblong with a fine metal saw. In this case it will be unnecessary to build frame

(*Continued on page* 971)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(*Continued from page 969*)

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## Book Review

MILITARY INTELLIGENCE, by Walter C. Sweeney, Lt. Colonel, U. S. Army. Hard covers 5" x 7½", 259 pages. Published by Frederick A. Stokes Co., New York City. $2.50.

The title of this book is somewhat misleading. It does not mean abstract intelligence of the intellect, but refers to the Intelligence Service, branch of the army, the transmitting of intelligence and the organization of service, covering espionage, censorship and the evaluation of information. The latter includes the sizing-up of information obtained from prisoners, and it gives the limitations of confidence to be placed in confessions extorted from prisoners. The theme is most scientifically worked out, but it is a book for the soldier and a book to be read. The absence of an index prevents it from being a really typical reference book.

THE TEN COMMANDMENTS IN THE ANIMAL WORLD, by Ernest Thompson Seton. Stiff cloth covers 4¾" x 7¾", 78 pages. Published by The Country Life Press, Garden City, N. Y. $1.00.

This interesting book by the famous Ernest Thompson Seton opens up a new line of philosophy and thought, and he shows how the animals line up in respect to the Ten Commandments which only man is supposed to understand and obey. The book is printed in large clear type and many interesting incidents from actual experience with animals are given. One of the very interesting and timely questions discussed is the endeavor in the animal kingdom to lead a monogamous life. "There is evidence that in the animal world there has long been a groping after an ideal form of marriage. Beginning with their promiscuity, they have worked through many stages into pure monogamy, and other things being equal, the species, owing to natural laws, are successful in proportion as they have reached it, and therefore have developed an instinctive recognition of the seventh commandment."

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## The Radio Constructor

By A. P. PECK

(*Continued from page 932*)

able to use a rheostat capable of fine adjustment. Therefore, the type, 8, shown in the photographs was employed. Being of the carbon-pile type, it gives very close adjustment, which is often quite desirable in reception.

Another very important point in the construction of a short-wave tuner is the use of a good type of grid leak. 6. It must be continuously variable and must be capable of holding its adjustment.

### AUDIO TRANSFORMER

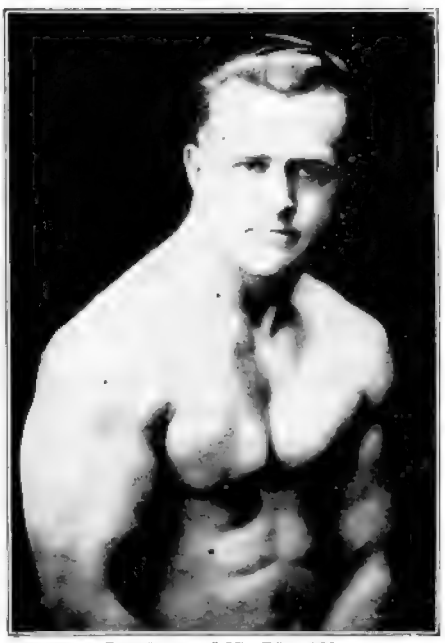
If you desire to make your short-wave receiver for C.W. reception only, and do not care particularly about listening to the broadcasting that is sent out on some few of the short waves, it is well to pay some attention to the selection of the audio frequency amplifying transformer used. There is one transformer on the market today, and that is the type used in this set, which gives the greatest amplification, when a note in the neighborhood of 1,000 cycles is to be amplified. This is approximately the frequency to which all C.W. signals are heterodyned when received by an oscillating receiver and, therefore, it will be found that a transformer of this type will give far greater amplification for C.W. reception than any other. This type of transformer is nothing at all radically new, because those that were in use in commercial and amateur work, before broadcast reception became such a part of our daily life, gave excellent results in just the same way. Therefore, if you have a very old type of audio frequency amplifying transformer on hand, it will probably give you much better results in a short-wave C.W. receiving set than it would in any broadcast receiving set. Use it by all means, or, if you wish to get the very best, obtain one of those transformers illustrated in the photographs here, 10. With the so-called "1,000-cycle" type of transformer, a fixed condenser of .0005 mf. capacity should be placed across the secondary.

A word about dials will not be amiss here. On the tuning control, it is quite essential that some sort of a very good vernier be employed.

### TUNING

After you get all of the instruments together and assemble them, following to a greater or lesser extent the layout shown, there is one main thing to observe before you attempt to do any DX reception. That is, be sure that the variable grid leak is correctly adjusted. To reach this point, turn the tuning condenser to minimum capacity and light both tubes to normal brilliancy. Advance the regeneration control until the detector tube oscillates. This point is determined by the fact that a loud click is heard in the phones. Now turn the regeneration control back until the set is not oscillating and adjust the grid leak a little. Soon you will find a setting for the leak, where the set will go from a non-oscillating to an oscillating condition without producing a loud click; only a soft hiss will be heard in the phones. This shows that you have the grid leak adjusted properly. Leave it at this point and it will probably be unnecessary to change its value until you substitute another detector tube for the one now in use.

When tuning for C.W. stations, keep the regeneration control at a point where the detector tube just oscillates. This is its most sensitive position. When the grid leak is properly adjusted, as described above, there is no trouble in keeping this place, but if the grid leak is out of adjustment, it will be found most difficult to control oscillation, the set will not be sensitive in operation and will not produce as loud signals as it will with a properly adjusted grid leak.

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The Muscle Builder

*Author of "Muscle Building," "Science of Wrestling," "Secrets of Strength," "Here's Health," Etc.*

# If You Were Dying To-night

and I offered something that would give you ten years more to live, would you take it? You'd grab it. Well, fellows, I've got it, but don't wait till you're dying or it won't do you a bit of good. It will then be too late. Right now is the time. To-morrow or any day, some disease will get you and if you have not equipped yourself to fight it off, you're gone. I don't claim to cure disease. I am not a medical doctor, but I'll put you in such condition that the doctor will starve to death waiting for you to take sick. Can you imagine a mosquito trying to bite a brick wall? A fine chance.

**A Re-Built Man**

I like to get the weak ones. I delight in getting hold of a man who has been turned down as hopeless by others. It's easy enough to finish a task that's more than half done. But give me the weak, sickly chap and watch him grow stronger. That's what I like. It's fun to me because I know I can do it and I like to give the other fellow the laugh. I don't just give you a veneer of muscle that looks good to others. I work on you both inside and out. I not only put big, massive arms and legs on you, but I build up those inner muscles that surround your vital organs. The kind that give you real pep and energy, the kind that fire you with ambition and the courage to tackle anything set before you.

**All I Ask Is Ninety Days**

Who says it takes years to get in shape? Show me the man who makes any such claims and I'll make him eat his words. I'll put one full inch on your arm in just 30 days. Yes, and two full inches on your chest in the same length of time. Meanwhile, I'm putting life and pep into your old back-bone. And from then on, just watch 'em grow. At the end of thirty days you won't know yourself. Your whole body will take on an entirely different appearance. But you've only started. Now comes the real works. I've only built my foundation. I want just 60 days more (90 in all) and you'll make those friends of yours who think they're strong look like something the cat dragged in.

**A Real Man**

When I'm through with you you're a real man. The kind that can prove it. You will be able to do things you had thought impossible. And the beauty of it is you keep on going. Your deep full chest breathes in rich, pure air, stimulating your blood and making you just bubble over with vim and vitality. Your huge square shoulders and your massive muscular arms have that craving for the exercise of a regular he man. You have the flash to your eye and the pep to your step that will make you admired and sought after in both the business and social world.

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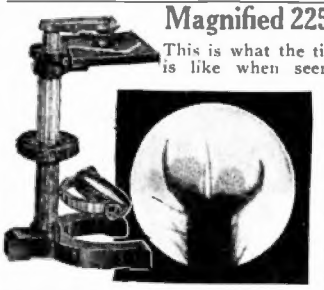

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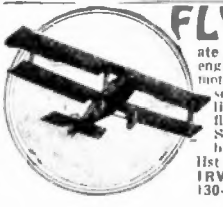

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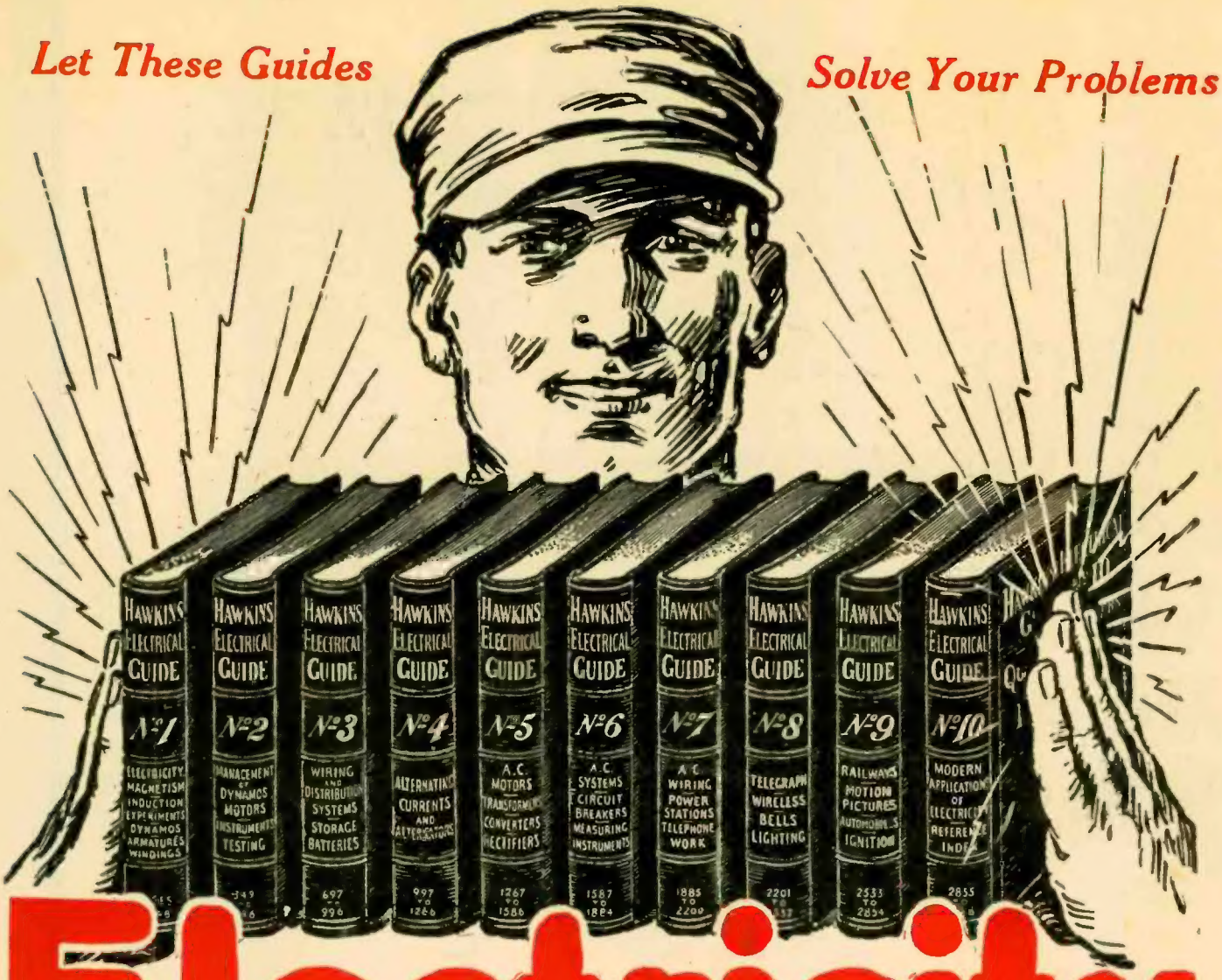


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